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SUMMARY

EFFECT OF THYME ESSENTIAL OILS TREATMENTS ON CATALASE AND POLIPHENOLOXIDASE ACTIVITY IN POTATO PLANTS INFECTED WITH AUCUBA VIRUS (PRELIMINARY STUDIES)

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Abstract: *Responses of thyme essential oils and H_2O_2 treatments were estimated in plants testing positive being infected with Potato Aucuba Mosaic Virus (PAMV), under drought conditions. Infected and uninfected micro plants transferred to a green-house were injected with a thyme essential oils suspension and sprayed twice a week with H_2O_2. The presence of virus decreased significantly catalase activity (CAT). Under drought stress, peroxidase (POX) activity increased significantly in infected plants, but the treatments only enhanced POX activity in uninfected plants compared to the CAT activity in the same experimental condition. An interesting role of thyme (Satureja hortensis) essential oils and H_2O_2 in lessening the potato PAMV infected plants behavior is suggested*

Keywords: *Satureja Hortensis essential oil, potato Aucuba mosaic virus, drought stress.*

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1. Introduction

For an Massive imports of potato in last years, the continuous "migration" of seed potatoes from one area to another, climate change, inadequate treatments for disease vector control (especially aphids), viral pressure, resistance of varieties are just some of the factors that may favor the spread of new viruses that recently appeared in the culture (Bădărău et al., 2021). One of these new virus is Potato Aucuba Mosaic Virus (PAMV), a pathogen transmitted mechanically and by *Myzus persicae* in a nonpersistent manner (Cojocaru N., 1987). The aphid transmission requires a helping potyvirus such as PVA (potato virus A) or PVY (potato virus Y) (Loebenstein G., 2008b). The damage caused by this pathogens agent is both quantitative (reduction of production) and qualitative (commercial depreciation of tubers). In case of cultivation of sensitive varieties under favorable conditions, financial losses can be important both for potato consumption (it can become unmarketable) as for seed potatoes (it will be downgraded). Thus, efforts to control this pathogen are essential when producing potatoes for market or seed (Bădărău et al., 2021).

Thyme *Satureja hortensis* L. (summer savory – Family *Lamiaceae*, order *Lamiales*) is known for its antiseptic (antimicrobial, antifungal and antiviral) properties. It inhibits mould formation. This oil contains hydro-carbonated and oxygenated compounds like α and β pinene, α tujene, camphene, sabinene, myrcene, α phelandren, terpinene, limonene, cymene, 1,8 cineol, β phelandrene, linalol, caryophillene. The main compounds are carvacrol (about 35%) – wich imprints the characteristic smell –tymol and p-cymene (Bedoux et al., 2010). They are also insect-repellent and antimicrobial, antiviral wich could protect the plants (Petersen et al., 2001).

Potato plants are very susceptible to water deficit (this could cause a severe reduction in leaf area, fresh weight and plant development (Heuer et al., 1998). Under drought conditions, the plants show an increase in reactive oxygen species (ROS) which leads to expression of genes associated with antioxidant functions for scavenging ROS, resulting in tolerance to

drought stress (Mano J., 2002). In the aim to minimise these ROS damaging effects, the plants envolved non-enzymatic and enzimatic antioxidants. Enzymatic defense, such as superoxide dismutase (SOD), catalase (CAT) and peroxidases (POXs) directly scavenge superoxyde radicals. H_2O_2, convert this radicals to less reactive species (Romero-Romero et al., 2009). In plant pathogen relationships, ROS are involved in induction of defense genes, antioxidant enzymes such as CAT and POX and accumulation of secondary metabolites (Pellinen et al., 2002).

There are limited information about occurence of symptoms with interaction between potato Aucuba virus and abiotic stress. Xu et al. (2008) showed in their papers that potato viruse infection improve drought tolerance (Wu et al., 1997). The goal of this preliminary research, was to study the effect of the virus – water stress interaction on the level of catalase and peroxidase activity in virus infected potato plants under essential oils treatments– mediated under greenhouse conditions.

2. Material and method

2.1 Plant material. Potato plants (PAMV positive material and negative controls from Castrum variety) were obtained from a previous selection under green house conditions. The infection of the material was confirmed by ELISA tests. Single node cuttings were *in vitro* propagated in test tubes on Murashige and Skoog (2005) medium, at 20±1°C under a 16 h photoperiod (fluorescent lights, 400–700 nm), in sterile conditions. Forty PAMV infected micro-plants and forty healthy micro-plants were transplanted to pots (17 x 14 cm) containing peat-moss under greenhouse conditions 30 days after the single-node subculture step. These plants were maintained under greenhouse conditions for 90 days after transplanting (DAT) and each pot was allocated to an experimental unit, with ten plants per treatment. Before the treatments and after 45 DAT the presence of PAMV was tested by ELISA.

ELISA test. A press with smooth roles was used for preparation leaf samples. The analysis was performed following essentially the protocol described by Clark and Adams (1977) (100 µl from each reactives solutions). Microplates were filled with substrate solution (p-nitrophenylphosphate) incubated 1 hour and the absorbance values were estimated at 405 nm (A_{405}) on Tecan reader (Magellan software). The samples having A_{405} values exceeding the cut-off (two times the average of healthy controls) were considered virus infected.

2.2 Stress and chemical treatments. All experiments were performed in triplicate. Micro-plants were transplanted to pots and after 7, 14 and 21 days, all the plants (excepting the controls) were injected with *Satureja hortensis* oil suspension (1/100) 10 units each plant. From 7 days later from the first injection, the plants were sprayed twice weekly for the next 2 months with 10 mL per plant of 1 mM H_2O_2 at pH 5.6 and the earth of the pots with 10mL essential oils suspension (1/1000). The fertilization was made every 15 days and the plants were watered twice a week. Ten infected plants and ten negative plants for each treatment were sprayed with H_2O_2 in randomized arrays and subjected to drought conditions. Drought stress (suppressed water) or well watered conditions were applied from 75 DAT up to harvest. Controls and plants untreated were sprayed with distilled water. Six infected (positive) and healthy (negative) plants were sprayed in randomized arrays for each chemical treatment, and each treatment was performed in three independent experiments.

2.3. Determination of CAT and POX activities. These analysis were made at 75 and 90 DAT in order to compare these parameters before and during drought stress and how the treatments mediated these responses. The enzyme extraction was performed using 59mM potassium phosphate buffer at pH 7,2, containing 5mM DTT (dithiotreithol), 1mM EDTA and 1% (w/v) PVP (Anderson MD, 1995). The extract was

centrifuged at 11627g for 15 minutes at 4°C. The supernatant was used for CAT and POX activities.

CAT (EC 1.11.1.6) activity was determined according to Aebi (1984). The total reaction mixture (3 ml) contained 50mM potassium and sodium phosphate buffer (pH 7) and 20 µl enzyme extract. The reaction was initiated by the addition of 30 mM H_2O_2. The decomposition was followed directly by the decrease in absorbance at 240 nm every 20 s for 3 minutes at 26°C.

POX (EC 1.11.1.7) activity was determined according to Mora-Herrera et al. (2007). The total reaction mixture (3 ml) contained 50mM potassium and sodium phosphate buffer (pH 7), 3.33mM guaiacol and 4mM H_2O_2 The reaction was initiated by addition of 20ml of the enzyme extract and progress measured directly by the increase in absorbance at 430 nm at 30 s intervals for 3 min at 25±1°C.

Statistical analysis. Data were analyzed by ANOVA and Duncan's Multiple Range Test and scored as significant if P<0.05 (IBM SPSS Statistics software).

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3. Results and discussions

In this work the effect of treatments with thyme (*Satureja hortensis* essential oils and H_2O_2, were compared on antioxidant responses (CAT and POX activities) of both healthy and virus infected (PAMV) potato plants (variety Castrum). The treatments with *Satureja hortensis* essential oils and H_2O_2 had a good effect on the diminution in stress-damage symptoms in infected plants.

Compared to uninfected plants, CAT activity decreased in infected plants, whereas essential oils and H_2O_2 did not induce significant changes (P<0.05%) (Fig.1).

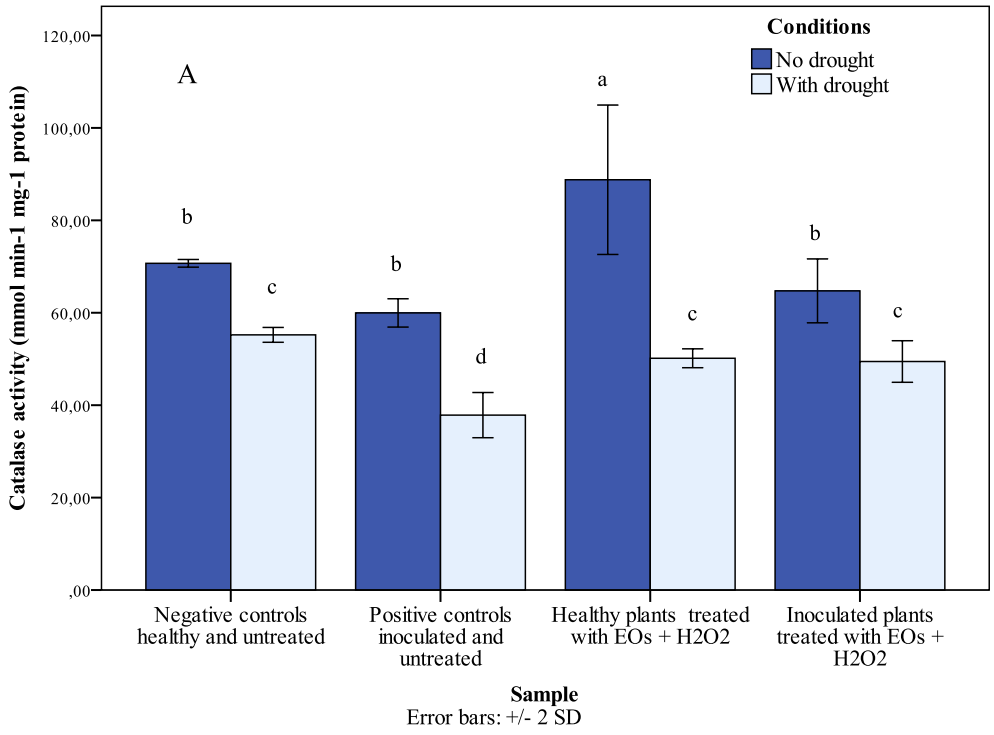

Fig. 1. *CAT activity of healthy plants and potato Aucuba mosaic virus (PAMV) infected plants, under drought conditions (■ dark colour of the bars) and not drought conditions (□ light colour of the bars), following treatments with Satureja hortensis (SH) essential oil and H_2O_2 (1mM) or water (controls), twice weekly from 30-75 DAT. Watering was withheld at 75 DAT. Data are means ± SD of 3 experiments. Bars with different letters differ significantly by ANOVA and Duncan's test (P<0.05).*

When drought stress was applied to plants, CAT activity significantly (P<0.05%) decreased compared to well-irrigated plants. Under drought stress, infected plants injected and

sprayed with essential oils suspension and sprayed with H_2O_2 had 40% increased CAT activity (fig 1).

Under optimal irrigation conditions, significant differences appeared in the POX activity affected by the PAMV presence. POX activity was augmented when the treatments were made on uninfected and infected plants. (fig 2). Under drought stress, POX activity increased significantly (P<0.05%) in infected plants, but the treatments only enhanced POX activity in uninfected plants compared to the CAT activity in the same experimental condition (fig 2).

We used a similar model like in other work (Bădărău et al., 2012) - a model based on the *in vitro*-to-green house system for investigate the effect of the interaction between the virus- water stress on the appearance of symptoms in infected plants treated with *S. hortensis* essential oils and H_2O_2 in mediated greenhouse conditions.

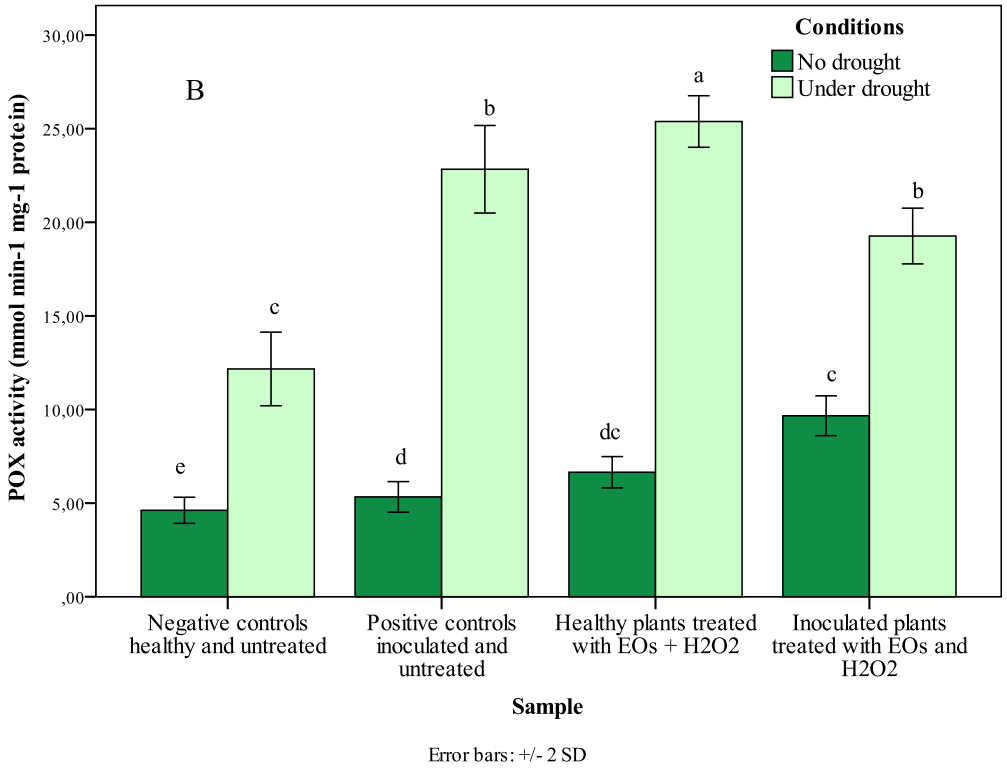

Fig. 2. *POX activity of healthy plants and potato Aucuba mosaic virus (PAMV) infected plants, under drought conditions (■ dark colour of the bars) and not drought conditions (□ light colour of the bars), following treatments with Satureja hortensis (SH) essential oil and H_2O_2 (1mM) or water (controls), twice weekly from 30-75 DAT. Watering was withheld at 75 DAT. Data are means ± SD of 3 experiments. Bars with different letters differ significantly by ANOVA and Duncan's test (P<0.05).*

As we have been reported (Bădărău et al. 2021) under green house conditions, the infected plants exhibited specific symptoms such as mosaic in the foliage, reduced plant weight and reduced tubers production (sometimes if the strain is very virulent systemic shock reaction and / plant death). Known symptoms usually for this kind of virus were absent under drought stress in the conditions of our experiments. In a green house the environmental stress was likely more stable with gradual changes compared to the field conditions where environmental changes can abruptly occur. The results obtained in this study confirmed that CAT inhibition is due to the virus. Essential oils and H_2O_2 application induced changes in CAT activity and H_2O_2 content,

especially under drought stress. No significant differences in CAT activity were observed before drought stress. Treatment promoted inhibition of CAT activity during drought, but only in presence of the virus (fig 1). Such enhancement could be important for the positive effects observed in tubers from inoculated plants. Interestingly, by the beginning of the drought stress (75DAT), essential oils and H_2O_2 application resulted in a significantly higher CAT activity values in PAMV inoculated plants compared to control plants, including the uninfected plants (fig 1). Such differences suggest a signaling role of unknown compounds of essential oils and of H_2O_2 that could maybe induce positive effects in minitubers from inoculated plants, reducing number, starch content and sprouting, as there was mentioned in another study (Bădărău et al. 2012).

The presence of potato Aucuba mosaic virus (PAMV) in potato plants induced augmentation of POX activity, as found to another pathogen and another plants (phytoplasma to apple trees, reported by Musseti et al. (2005). The drought effect on POX activity was amplified by essential oils and H_2O_2 application on uninfected.

There are scarce information on the combined tolerance to biotic and abiotic stress. This research study demonstrates an ameliorative effect of the essential oils and H_2O_2 on the combined stresses. We presented the effect of PAMV-water stress on the occurence of symptoms and the antioxidant response in virus infected potato plants under H_2O_2 –mediated greenhouse condition. As we have been reported for another virus (Bădărău et al., 2012), the treatments with essential oils suspension and low H_2O_2 concentration 1mM significantly reduced disease symptoms under drought stress for minituber production and starch accumulation, with repercussions in minituber size augmentation and induced multiple sprouting. The practical use of these treatments for overcoming damage in non-seed tubers, is a strong justification for continue investigation of the physiology and the effect of some compounds from *S. hortensis* essential oils and of H_2O_2.

4. Conclusions

The treatments with *Satureja hortensis* essential oils and H_2O_2 were favourable for diminution the stress-damage in infected plants under drought conditions, these aspects being highlight by a significant increase of cathalase and peroxidase activity of treated material. So, under drought stress, infected plants injected and sprayed with essential oils suspension and sprayed with H_2O_2 had 40% increased CAT.

Further research is needed to determine the effects of treatments applied in this research in the aim to estimate the influence of catalase and peroxidase activity on the tuber sprouting.

Acknowlegments This work was supported by the project ADER 511, “Research regarding the seed potato viruses control and the study of the behavior of Romanian potato breeding lines and varieties in the presence of new viruses with high potential in the context of climate change”, project number 511/27.09.2019.

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INVENTORY OF EPIPHYTIC LICHENS IN THE CEDARS OF OUANOUGHA AND MAADID (MOUNTS OF HODNA, ALGERIA)

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Abstract: *The authors present the unpublished inventory of epiphytic lichens in the cedar forests of the Hodna region. This inventory constitutes a database of the lichens of the Hodna mountains in particular and an enrichment of the list of Algerian lichenoflora in general. Thirty stations spread over three study areas were studied and characterized by the calculation of various parameters. After the collection and identification of the lichen samples, the study area is home to 51 lichen taxa spread over 14 families, the most represented of which are the Physciaseae (16 species), Parmeliaceae (07 species), Lecanoraceae (06 species), Ramalinaceae (06 species).*

From a physiognomic point of view, foliose lichens are the most dominant with 44.31% followed by crustaceans 34.09 %, fruticose 15.36 % and finally scaly and gelatinous and leprous with respectively 02.27 %, 02.27% and 01.13 %. Specifically, the 31 lichen species are present on cedar, with a clear dominance of the genus Physcia and Parmelia followed by the genus Lecanora then Ramalina. From the lichen floristic richness point of view, the cedar forest represents a ratio of 31/51 species (60.78 %) of the local lichen diversity.

The Ouanougha cedar forest is richer than the Maadid cedar forest, this can be partly explained by the fact that the latter is much more degraded (in advanced decline) than the first which benefits from the humid influences of Djurdjura.

Keywords:*Inventory, Lichens, Cedars, Hodna Mountains, Algeria*

1. Introduction

The Hodna region is remarkable for its richness and the originality of its flora [1]. This region has been recognized as one of the "hot spots" of plant biodiversity [2] and as an "important for plants" area in Algeria [3]. According to Boudy (1955), lichens present a great biological diversity in natural environments, by the many forms they present and by their peculiarities of adaptation to ecological variables [4].

Lichens are still poorly known to naturalists and knowledge of the species also remains very imperfect, more particularly in Mediterranean forests which constitute a fragile natural environment [5].

According to the literature, several botanical inventories devoted to the lichen flora of Algeria such as: Desfontaines (1798-1799) [6], Steinheil (1834) [7], Montagne (1838-1846) [8,9], Durieu (1846) [10], Nylander (1853-1854-1858-1864) [11,12,13,14], Reboud (1867) [15], Flagey (1888-1891-1892-1895-1896) [16,17,18,19,20], Steiner (1902) [21], Zahlbruckner (1904) [22], Maheu (1906) [23], Bouly de Lesdain (1911) [24], Werner (1941-49) [25,26], Faurel *et al*. (1952abc-1953ab-1954ab) [27,28,29,30,31,32,33], Collenot *et al*. (1960) [34]. Work in lichenology continued in Algeria, particularly in the West, East and Center of the country, as part of the preparation of end-of-study dissertations and doctoral theses. Several works in this field have been published in scientific journals.

Then a new renewal of interest will begin with the work of Werner (1975) [35], Esnault & Roux (1987) [36], Egea (1988) [37], Semadi (1988-1989) [38,39], Djellil (1989) [40], Van Haluwyn & Letrouit-Galinou (1990) [41], Egea *et al*. (1990) [42], Van Haluwyn *et al*. (1994) [43], Semadi *et al*. (1995-1997) [44,45], Boutabia (2000) [46], Rahali 2003 [47] followed by Rico *et al*. (2007) [48], Abbar (2009) [49], Fadel *et al*. (2010) [50], Ait Hammou *et al*. (2011) [51], Rebbas *et al*. (2012) [52], Slimani *et al*. (2013) [53], Ait Hammou (2014-2015) [54,55], Lograda *et al*. (2015) [56], Boutabia *et al*. (2015, 2018) [57,58], Ghennam & Abdoun (2017) [59], Bendaikha (2018) [60], Khedim (2018) [61],

Chermat (2019) [62], Hamralaine *et al*. (2019) [63], Yahia & Marniche (2019) [64], Belguidoum *et al*. (2021) [65], Chaker *et al*. (2021) [66], Maazouz *et al*. (2022) [67].

What is remarkable, the little work on the lichens of southern Algeria and the highlands. Nevertheless, a synthesis on the lichens of Algeria was made by Ait Hammou *et al*. (2014) [54], and Amrani *et al*. (2015-2018) [68, 69]. This work will undoubtedly constitute an important contribution to the knowledge of the regional lichen flora of the Hodna mountains. The objective is to establish an inventory of epiphytic lichens and to characterize the lichen processions of the sites according to the different compartments and natural habitats.

2. Material and method

2. 1. Physical setting of the study area

The study area covers the forest of Maadid, with that of Ouanougha, has about 7807 hectares, formed mainly by juniper (*Junipersus oxycedrus*), holm oak (*Quercus ilex* subsp. *ballota*), cedar (*Cedrus atlantica*) and pine. Aleppo (*Pinus halepensis*). A forest that is distinguished by a significant number of woody species (trees and shrubs). Unfortunately, this flora is now generally degraded as a whole.

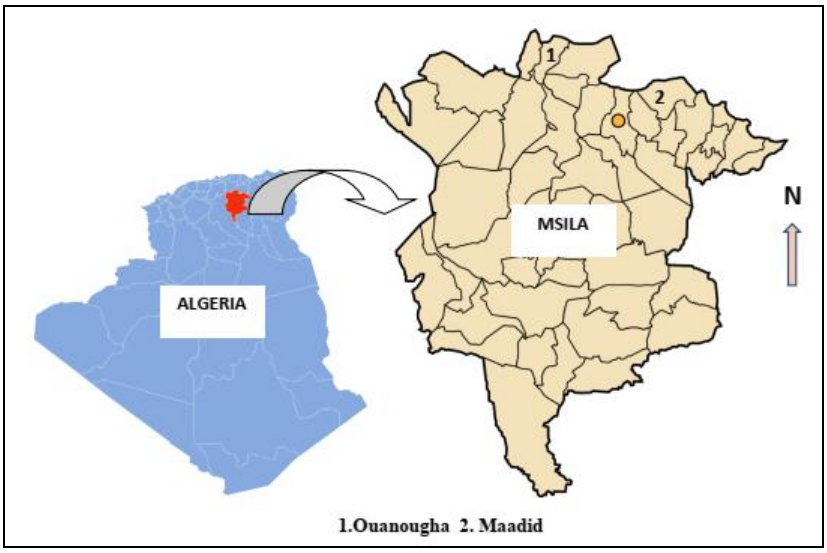

Fig. 1. *Geographical location of the study area*

The territory of the Wilaya of M'sila is located in the high plateau area between the two mountain ranges which are the Atlas Tellien and the Saharan Atlas on an altitude varying on average between 400 and 1600 m.

Despite the steppe vocation of the wilaya, the mountain area covering a large area of 199,925 Ha, it represents 7% of the territory, spread over a few forest massifs of great ecological value, in particular the cedar forest of Maadid and that of Ouanougha.

Fig. 2. *Ouanougha cedar forest (Photo K. Rebbas, 2020)*

Fig. 3. *Maadid cedar forest (Photo K. Rebbas, 2019)*

Endemic and present in a spontaneous state in the mountains of the Maghreb, *Cedrus atlantica* represents par excellence the noble essence of the Algerian forests [70]. The cedar has been known since the work of Maire (1926) [71] as a relatively xerophilic tree, supporting a dry climate in summer and cold in winter, it resists temperatures of - 0 degrees.

From an ecological point of view, the cedar forests of Hodna, developed in a bioclimatic environment at the limit of semi-arid and sub-humid bioclimates, are characterized by annual rainfall of between 500 and 800 mm.

Located at the absolute southern limit of the distribution area of cedars. They grow on a substrate characterized by limestone, marl and sandstone series from the Cretaceous. Not very effectively protected, these cedar forests are in a very advanced state of degradation, particularly within Djebel Maadid where they only exist as a relic [72].

Having a very heterogeneous structure, it presents a very irregular stratification: The tree stratum (average height of 20 m). Very low density, consists exclusively of cedar represented by very old subjects. The rest of the formation is clearing with a shrubby stratum, very scarce (*Crataegus laciniata, Juniperus oxycedrus, Quercus ilex* subsp. *ballota*). The floristic procession is very poor compared to the cedar forests linked to the humid bioclimate of the sublittoral Tell. From a dynamic point of view, the absence of cedar regeneration is an indication of a regressive evolution of the cedar forests of the Hodna Mountains. Cedar occupies the northern slopes of the highest massifs of the Hodna and Bibans mountains (Djebels Afghane, 1890 m; Maadid, Righa-Dahra, 1600 m and Ouanougha 1500 m) [72].

2. 2. Method of studying and identifying lichens

After a preliminary analysis of the cartographic data available, a punctual inventory was carried out according to a path walking in the study site with the objective of traversing the maximum of types of forest environments. The harvest of plant material was made on different parts of the plant (Lichens: corticoles, lignicoles and folicoles).

Initially, all available phorophyte species *Crataegus laciniata, Juniperus oxycedrus, Quercus ilex* subsp. *ballota, Olea europea*, *Cedrus atlantica* and *Pinus halepensis* are visited in order to harvest the maximum number of lichen species present in the study area. Then in a second part the lichen species present on the cedar are noted apart from estimating the lichen biodiversity of the cedar in relation to the entire forest formation.

30 inventory points (micro stations) were chosen semi-randomly and stratified (altitudes). The main natural habitats present, identified beforehand, are covered. The protocol was implemented in three main study areas: Ouanougha, Maadid North and Maadid South.
Several sampling campaigns were carried out during the period from April 2018 to November 2019. Hundreds of thalli of different species were collected.

Identification of lichen samples is initiated in the field where samples are determined at least to genus. Afterwards the samples collected are determined in the laboratory, using stereoscopic binocular magnifying glasses (linear magnification from x10 to x40) and microscopes (x40, x100, x400 magnifications).

Species identification is first made by observing general morphological characteristics, such as shape, color, frond diameter as well as frond tip orientation and branching type. Observation under a binocular microscope reveals the presence or absence of cilia, soralia, isidia as well as apothecary structures. Identification is supported by colorimetric reactions, which give different reactions depending on the species. The reagents are applied directly to the thalli, on a surface free of impurities beforehand. Thus, we used the reagents usually used in lichenology: Potash (10% solution), commercial bleach, lugol, paraphenylene diamine in 2% alcoholic solution.

The main works used for the determination are the flora of Ozenda and Clauzade (1970) [73], the flora "The lichen flora of Great Britain and Ireland" of Purvis *et al.* (1992) [74] and Van Haluwyn & Lerond's guide to lichens (1993) [75].

2.2.1. Inventory and collection of lichens in the cedar forest

In each of the micro stations, five feet of cedar all having a vertical trunk and the same diameters (varying from 120cm to 150cm) are chosen to make readings. Lichen vegetation surveys are carried out using the technique of Crespo & Bueno (1982) [76]. The list of all the species present on the trunk is drawn up whatever the exposure.

Parameters characterizing the species

In each station (Sx), each species (e) is characterized by: The number of companion species in the station is: n(Sx) – 1. With n(Sx): number of species observed in the station Sx. The total presence Pt which is equal to the number of stations where the species is present Average presence Pm which is equal to the number of readings where the species is present (Ce) divided by the number of readings carried out (C): Pm= C(e) /C

Parameters characterizing the station and the floristic composition

Each region is characterized by:

1. Number of species recorded in the station.
2. Lists of species: obtained by combining the list of species recorded
3. The floristic richness D: the ratio of the number of species of this station to the number of species of the richest station.

3. Results and discussion

3.1. Lichen species inventoried in the Hodna Mountains

After collecting and identifying the samples, we identified 51 lichen species spread over 18 families, the most dominant of which are the Physciaseae (16 species), Parmeliaceae (7 species), followed by Lecanoraceae and Ramalinaceae of 6 species. From the physiognomic point of view, foliose lichens are dominant with 49.01% followed by crustaceans 35.29%, fruticose 9.80% and finally gelatinous and leprous with respectively 3.92% and 1.96%.

Table 1. *Global list of lichen species inventoried in the Hodna Mountains (Maadid and Ouanougha cedar forests) M'Sila, Algeria*

N°	*Espèce*	Famille	Type de thalle
1	*Anaptychia ciliaris* (L.) Körb. ex A. Massal. subsp. *ciliaris*	Physciaceae	Foliacé
2	*Bacidia rubella* (Hoffm.) Massal.	Ramalinaceae	Crustacé

3	*Caloplaca cerina* (Eheh.ex Hedw.) Th.Fr.	Telochistaceae	Crustacé
4	*Caloplaca pyracea* (Ach.) Th. Fr.	Telochistaceae	Crustacé
5	*Collema furfuraceum (*Arnold) Du Rietz	Collemataceae	Foliacé
6	*Diploicia canescens* (Dicks.) A.Massal.	Caliciaceae	Crustacé
7	*Evernia prunastri* (L.) Ach.	Parmeliaceae	Fruticuleux
8	*Flavoparmelia caperata* (L.) Hal form *caperata*	Parmeliaceae	Foliacé
9	*Hyperphyscia adglutinata* (Flörke) H.Mayrhofer & Poelt	Physciaceae	Foliacé
10	*Hypogymnia physodes* (L.) Nyl.	Parmeliaceae	Foliacé
11	*Lecanactis paterllaroides* (Nyl.) Vain	Roccellaceae	Crustacé
12	*Lecania naegelii* (Hepp) Diederich et Van den Boom	Ramalinaceae	Crustacé
13	*Lecanora carpinea* (L.) Vain.	Lecanoraceae	Crustacé
14	*Lecanora chlarotera* Nyl. *subsp. chlarotera*	Lecanoraceae	Crustacé
15	*Lecanora dispersa* B. de Lesd.	Lecanoraceae	Crustacé
16	*Lecanora expallens* Ach.	Lecanoraceae	Crustacé
17	*Lecanora horiza* (Ach.) Linds.	Arthoniaceae	Crustacé
18	*Lecanora siena* B. de Lesd.	Lecanoraceae	Crustacé
19	*Lecidella elaechroma* (Ach.) M.Choisy	Lecanoraceae	Crustacé
20	*Lecidella euphorea* (Flörke) Hertel	Lecanoraceae	Crustacé
21	*Lepra albescens* (Huds.) Hafellner	Pertusariaceae	Crustacé
22	*Leprarea incana* L. Ach.	Steriocaulaceae	Lépreux
23	*Leptochidium albociliatum* (Desm.) M. Choisy	Massalongiaceae	Foliacé
24	*lobaria virens* (With.) J.R.	Lobariaceae	Foliacé
25	*Parmelia saxatilis* (L.) Ach.	Parmeliaceae	Foliacé
26	*Parmelia sulcata* Taylor s.l.	Parmeliaceae	Foliacé
27	*Parmelia tiliacea* (Hoffm.) Hale	Parmeliaceae	Foliacé
28	*Phaeophyscia ciliata* (Hoffm.) Moberg	Physciaceae	Foliacé
29	*Phaeophyscia hizuta* (Mereschk.) Essl.	Physciaceae	Foliacé
30	*Phaeophyscia orbicularis* (Neck.) Moberg	Physciaceae	Foliacé
31	*Phlyctis argena* (Spreng.) Flot.	Phlyctidaceae	Crustacé
32	*Physcia adscendens* (Fr.) H.Olivier	Physciaceae	Foliacé
33	*Physcia aipolia* (Ehrh. ex Humb.) Fürnr.	Physciaceae	Foliacé
34	*Physcia biziana* (A.Massal.) Zahlbr.	Physciaceae	Foliacé
35	*Physcia clementei* (Turner) Lynge	Physciaceae	Foliacé
36	*Physcia stellaris* (L.) Nyl.	Physciaceae	Foliacé
37	*Physcia tenella* (Scop.) DC.	Physciaceae	Foliacé
38	*Physconia distorta* (With.) J. R. v*ar. distorta*	Physciaceae	Foliacé
39	*Physconia distorta var. subvenusta* (Cromb.)	Physciaceae	Foliacé
40	*Physconia perisidiosa* (Erichsen) Moberg	Physciaceae	Foliacé
41	*Physconia venusta* (Ach.) Poelt	Physciaceae	Foliacé
42	*Pleurosticta acetabulum* (Neck.) Elix & Lumbsch	Parmeliaceae	Foliacé
43	*Ramalina farinacea* (L.) Ach.	Ramalinaceae	Fruticuleux
44	*Ramalina fastigiata* (Pers.) Ach.	Ramalinaceae	Fruticuleux
45	*Ramalina fraxinea* (L.) Ach.	Ramalinaceae	Fruticuleux
46	*Ramalina pollinaria* (Westr.) Ach.	Ramalinaceae	Fruticuleux
47	*Rinodina roboris* (Dufour ex Nyl.) Arnold	Physciaceae	Crustacé
48	*Schismatomma pericleum* (Ach.) Branth & Rostr.	Roccellaceae	Crustacé
49	*Scytinium gelatinosum* (With.) Otálora, P.M.Jørg. & Wedin	Collemataceae	Gelatineux
50	*Scytinium lichenoides* (L.) Otálora, P.M.Jørg. & Wedin	Collemataceae	Gelatineux
51	*Xanthoria parietina* (L.) Th.Fr.	Telochistaceae	Foliacé

The most common species in the study area are: *Anaptichia ciliaris, Physcia adscendens, Phlyctis argena, Parmelia acetabulum, Bacidia nageli, Collema furfuraceum, Lecanora clarothera and Xanthoria parietina.*

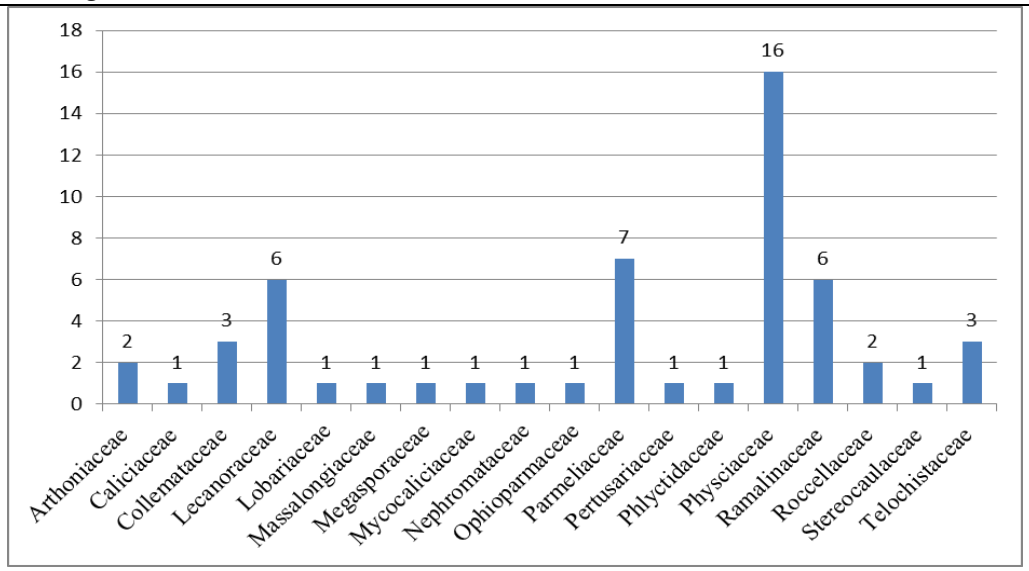

Fig. 4. *Distribution of species according to families*

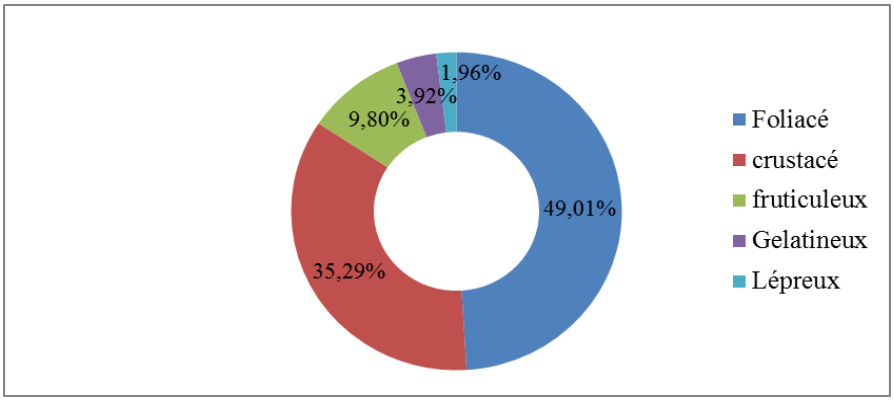

Fig. 5. *Physiognomic appearance of the lichens inventoried*

3.2.Lichens in the cedar forest

Specifically, 31 lichen species present on cedar have been identified, with a clear dominance of the genus Physcia and Parmelia followed by the genus Lecanora then Ramalina. From the lichen floristic richness point of view, the cedar forest represents a ratio of 31/51 species, namely (60.78%) of the local lichen diversity. The 31 inventoried taxa are spread over 12 Families, the most represented of which are the Physciaseae 06 taxa, Parmeliaceae 06, Lecanoraceae 05, Ramalinaceae 04 taxa.

From the physiognomic point of view, foliaceous and crustose lichens are dominant with the same rate of 41.93% followed by fruticose 9.67% and finally gelatinous and leprous with 3.22% and 3.22% respectively.

Table 2. *List of lichen species inventoried on the phorophyte Cedrus atlantica*

N°	Espèce
1	*Anaptychia ciliaris* (L.) Körb. ex A. Massal. subsp. *ciliaris*
2	*Bacidia rubella* (Hoffm.) Massal.
3	*Caloplaca pyracea* (Ach.) Th. Fr.
4	*Collema furfuraceum* (Arnold) Du Rietz
5	*Diploicia canescens* (Dicks.) A.Massal.
6	*Evernia prunastri* (L.) Ach.
7	*Flavoparmelia caperata* (L.) Hal form *caperata*
8	*Hyperphyscia adglutinata* (Flörke) H.Mayrhofer & Poelt
9	*Hypogymnia physodes* (L.) Nyl.
10	*Lecanactis paterllaroides* (Nyl.) Vain

11	*Lecania naegelii* (Hepp) Diederich et Van den Boom
12	*Lecanora chlarotera* Nyl. *subsp. chlarotera*
13	*Lecanora expallens* Ach.
14	*Lecanora horiza* (Ach.) Linds.
15	*Lecanora siena* B. de Lesd.
16	*Lecidella elaechroma* (Ach.) M.Choisy
17	*Lecidella euphorea* (Flörke) Hertel
18	*Lepra albescens* (Huds.) Hafellner
19	*Leprarea incana* L. Ach.
20	*Parmelia sulcata* Taylor s.l.
21	*Parmelia tiliacea* (Hoffm.) Hale
22	*Phaeophyscia hizuta* (Mereschk.) Essl.
23	*Phlyctis argena* (Spreng.) Flot.
24	*Physcia adscendens* (Fr.) H.Olivier
25	*Physcia stellaris* (L.) Nyl.
26	*Physcia tenella* (Scop.) DC.
27	*Pleurosticta acetabulum* (Neck.) Elix & Lumbsch
28	*Ramalina farinacea* (L.) Ach.
29	*Ramalina fraxinea* (L.) Ach.
30	*Scytinium lichenoides* (L.) Otálora, P.M.Jørg. & Wedin
31	*Xanthoria parietina* (L.) Th.Fr.

The diversity of lichens on cedar for the three stations was slightly heterogeneous: Ouanougha 30 species, North Maadid 27 species and South Maadid 23 species. This can be explained by the extraordinary diversification of topographic and microclimatic conditions, the difference in density of plant stands in each station (adult and young stands, closed and open) and finally the intensity of anthropogenic actions. The stations in the Ouanougha region are very close in terms of number of species, therefore indices of similar diversity. The richest station is S4 with 18 species and the least rich station S8 with only 8 species (Annex 1).

For the stations in the Maadid North region, there are significant variations in terms of the number of species between stations, such as station S10 with 6 species and station S5 with 17 species, in this case an index of double diversity (Annex 2).

On the other hand, in the stations of the Maadid South region, we note that the lichen flora is the least rich of the three zones studied with a number of species which is around 7 to 8 taxa per station with the lowest diversity indices. The richest station is S4 with 14 species and the least rich stations S7, S2 and S9 with only 7 species (Annex 3).

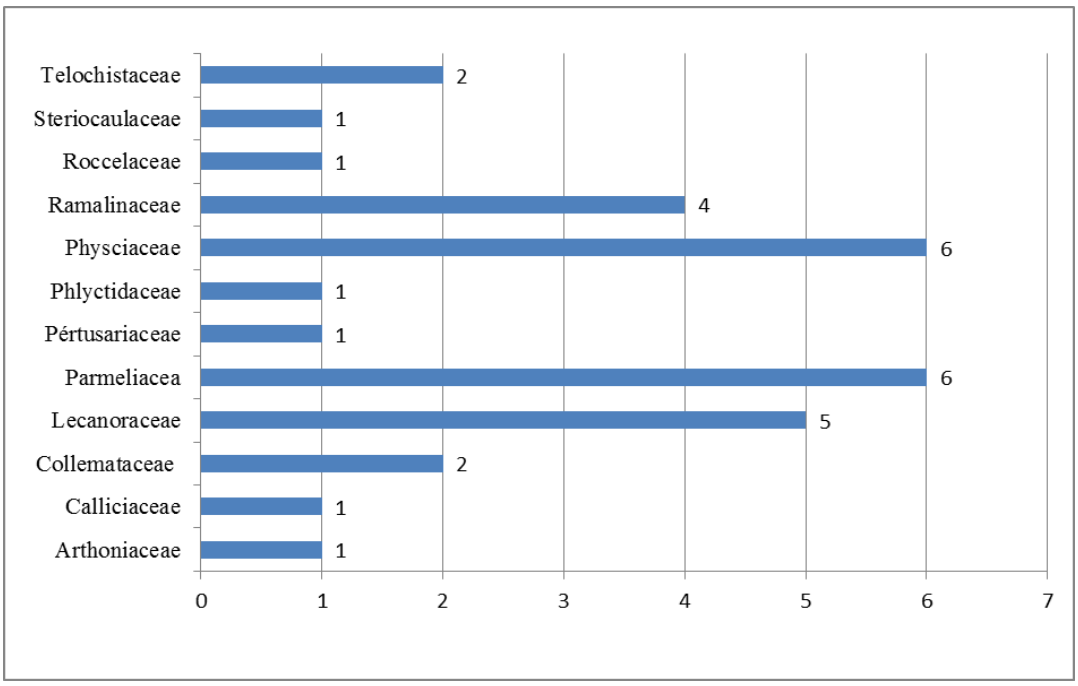

Fig. 6. *Distribution of species by family (cedar section)*

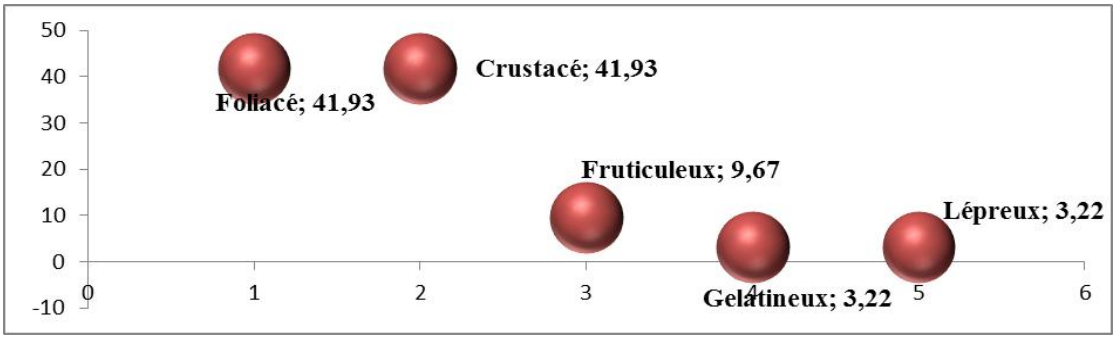

Fig. 7. *Physiognomic appearance of the inventoried lichens (cedar section)*

This inventory of lichens in the cedar forests of Hodna (M'sila region), constitutes a modest work but without doubt an important and unprecedented contribution to the knowledge of the regional lichen flora.

By comparing our results with previous work, we see that the number of species is slightly lower than the number of taxa found in other cedar forests in Algeria such as Khedim (2018) [61] at Theniat Elhad (70 species), Belguidoum *et al*. (2021) [65] in the Babors region (66 species) and Chaker *et al.* (2021) [66] in the Djurdjura (70 species) all genera combined.

This is logical knowing that the Hodna cedar forest is located in a bioclimatic environment located at the absolute southern limit of the cedar forest distribution area and it is subject to a very accentuated xenophilia predominance of hot winds (sirocco), which has negatively influenced on the plant cover and constitutes a real danger for the corticolous or epiphyte lichen flora which continues to decline as the forest degrades.

Conclusion

The cedar forests of Ouanougha and Maadid are home to 51 lichen taxa spread over 14 families, of which the most represented are Physciaceae 15, Parmeliaceae 9 taxa, Lecanoraceae, Ramalinaceae 6 taxa. From the physiognomic point of view the foliaceous lichens are dominant with 49.01% followed by the crustaceans 35.29%, the fruticose 9.82% and finally the gelatinous and the lepers with respectively 3.92% and 01.96%.

The cedar forest considered alone includes 31 lichen species, i.e. a rate of 50% of the total recorded. The 31 taxa inventoried are spread over 8 Families, i.e.

Finally, in general, the diversity of lichens on cedar for the three stations proved to be slightly heterogeneous (Ouanougha 30 species,

Maadid North 27 species and Maadid South 23 species. This can be explained by the extraordinary diversity of topographic conditions, microclimatic, the difference in density of plant stands and the number of species in place in each station (adult and young stands, closed and open).

This inventory of the lichens of the cedar forests of Hodna constitutes a modest work but without doubt an important contribution to the knowledge of the regional lichen flora.

It emerges from our observations in the field that the lichen epiphytic flora of the sites to be studied is in regression, however there is a strong biological potential of soil and saxicolous lichens in the surveyed region, the work that we wish to carry out by way of perspective in the near future after this study.

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ANNEX 1
D= (diversity index)

Area 1 : Ouanougha

		Micro-stations	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
		Number of trees	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
		Number of species	**13**	**12**	**15**	**18**	**15**	**12**	**13**	**13**	**8**	**9**
		D	**0.72**	**0,66**	**0,83**	**1**	**0,83**	**0,66**	**0.72**	**0.72**	**0,44**	**0,5**
Species	**Pt**	**Pm**										
Anaptychia ciliaris (L.) Körb. ex A. Massal. subsp. *ciliaris*	**10**	**43**	X	X	X	X	X	X	X	X	X	X
Bacidia rubella (Hoffm.) Massal.	**5**	23		X			X	X	X	X		
Caloplaca pyracea (Ach.) Th. Fr.	**3**	9					X	X	X			
*Collema furfuraceum (*Arnold) Du Rietz	**7**	26		X	X	X	X		X	X		X
Diploicia canescens (Dicks.) A.Massal.	**3**	8			X		X	X				
Evernia prunastri (L.) Ach.	**6**	27	X	X		X			X	X		X
Flavoparmelia caperata (L.) Hal form *caperata*	**3**	12		X	X	X						
Hyperphyscia adglutinata (Flörke) H.Mayrhofer & Poelt	**5**	29	X		X		X	X	X			X
Hypogymnia physodes (L.) Nyl.	**5**	26		X				X	X	X	X	
Lecanactis paterllaroides (Nyl.) Vain	**6**	23	X		X	X		X		X	X	
Lecania naegelii (Hepp) Diederich et Van den Boom	**4**	13		X	X	X					X	
Lecanora chlarotera Nyl. subsp. *chlarotera*	**4**	26	X		X			X	X	X		
Lecanora expallens Ach.	**2**	13		X		X						
Lecanora horiza (Ach.) Linds.	**3**	11				X		X	X			
Lecanora siena B. de Lesd.	**2**	7	X	X								
Lecidella elaechroma (Ach.) M.Choisy	**2**	6		X					X			
Lecidella euphorea (Flörke) Hertel	**3**	13	X		X	X						
Lepra albescens (Huds.) Hafellner	**6**	18	X		X		X	X	X			
Leprarea incana L. Ach.	**1**	2					X					
Parmelia sulcata Taylor s.l.	**6**	27	X		X	X	X				X	X
Parmelia tiliacea (Hoffm.) Hale	**1**	2								X		
Phaeophyscia hizuta (Mereschk.) Essl.	**3**	6	X			X	X					
Phlyctis argena (Spreng.) Flot.	**6**	13			X	X	X		X	X	X	
Physcia adscendens (Fr.) H.Olivier	**7**	27		X	X	X	X	X		X	X	
Physcia stellaris (L.) Nyl.	**3**	6			X	X				X		
Physcia tenella (Scop.) DC.	**1**	1										
Pleurosticta acetabulum (Neck.) Elix & Lumbsch	**5**	10	X			X	X			X		X
Ramalina farinacea (L.) Ach	**4**	8	X			X	X					X
Ramalina fraxinea (L.) Ach.	**2**	6				X						X
Scytinium lichenoides (L.) Otálora, P.M.Jørg. & Wedin	**0**	0										
Xanthoria parietina (L.) Th.Fr.	**10**	**43**	X	X	X	X	X	X	X	X	X	X

ANNEX 2
D=(diversity index)

Area 2 : Maadid nord

		Micro-stations	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
		Number of trees	5	5	5	5	5	5	5	5	5	5
		Number of species	11	13	10	15	17	12	11	9	8	6
		D	0,64	0,76	0,58	0,88	1	70	0,64	0,52	0,47	0,52
Species	**Pt**	**Pm**										
Anaptychia ciliaris (L.) Körb. ex A. Massal. subsp. *ciliaris*	**10**	**39**	X	X		X	X	X	X	X	X	X
Bacidia rubella (Hoffm.) Massal.	**3**	7		X		X	X					
Caloplaca pyracea (Ach.) Th. Fr.	**3**	9		X			X		X			
*Collema furfuraceum (*Arnold) Du Rietz	**7**	23	X	X	X		X	X		X		X
Diploicia canescens (Dicks.) A.Massal.	**7**	21		X	X	X	X		X	X	X	
Evernia prunastri (L.) Ach.	**1**	7			X	X						
Flavoparmelia caperata (L.) Hal form *caperata*	**6**	13	X		X	X		X	X	X		
Hyperphyscia adglutinata (Flörke) H.Mayrhofer & Poelt	**5**	19		X	X		X	X	X	X		
Hypogymnia physodes (L.) Nyl.	**1**	2							X			
Lecanactis paterllaroides (Nyl.) Vain	**3**	9		X			X				X	
Lecania naegelii (Hepp) Diederich et Van den Boom	**6**	16	X				X		X	X	X	
Lecanora chlarotera Nyl. subsp. *chlarotera*	**4**	13	X	X		X		X				
Lecanora expallens Ach.	**2**	3			X				X			
Lecanora horiza (Ach.) Linds.	**3**	6		X		X		X				
Lecanora siena B. de Lesd.	**2**	7				x	x			X		X
Lecidella elaechroma (Ach.) M.Choisy	**7**	23		X	X	X	X	X			X	X
Lecidella euphorea (Flörke) Hertel	**1**	1		X								
Lepra albescens (Huds.) Hafellner	**3**	7	X				X		X			
Leprarea incana L. Ach.	**2**	3					X	X				
Parmelia sulcata Taylor s.l.	**0**	0										
Parmelia tiliacea (Hoffm.) Hale	**0**	0										
Phaeophyscia hizuta (Mereschk.) Essl.	**2**	3				X	X					
Phlyctis argena (Spreng.) Flot.	**3**	3	X		X	X						
Physcia adscendens (Fr.) H.Olivier	**8**	27	X	X	X		X	X		X	X	X
Physcia stellaris (L.) Nyl.	**0**	0										
Physcia tenella (Scop.) DC.	**0**	0										
Pleurosticta acetabulum (Neck.) Elix & Lumbsch	**6**	10	X			X	X	X	X	X		
Ramalina farinacea (L.) Ach.	**3**	8	X			X	X					
Ramalina fraxinea (L.) Ach.	**2**	6				X		X				
Scytinium lichenoides (L.) Otálora, P.M.Jørg. & Wedin	**1**	0									X	
Xanthoria parietina (L.) Th.Fr.	**9**	**42**	X	X	X	X	X	X	X		X	X

ANNEX 3
D= (diversity index)

Area 3 : Maadid Sud

		Micro-stations	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
		Number of trees		**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
		Number of species	**9**	**7**	**10**	**14**	**13**	**8**	**7**	**8**	**7**	**13**
		D	**0,64**	**0,5**	**0,71**	**1**	**0,92**	**0,57**	**0,5**	**0,57**	**0,5**	**0,92**
Species	**Pt**	**Pm**										
Anaptychia ciliaris (L.) Körb. ex A. Massal. subsp. *ciliaris*	**8**	**39**	X	X	X	X	X	X		X		X
Xanthoria parietina (L.) Th.Fr.	8	**40**		X	X	X		X	X	X	X	X
Bacidia rubella (Hoffm.) Massal.	**7**	23	X		X		X	X	X	X		X
Caloplaca pyracea (Ach.) Th. Fr.	**7**	13	X	X	X	X	X				X	X
*Collema furfuraceum (*Arnold) Du Rietz	**6**	20	X			X	X		X	X		X
Diploicia canescens (Dicks.) A.Massal.	**5**	13			X	X	X			X	X	
Evernia prunastri (L.) Ach	**5**	8		X	X				X		X	X
Flavoparmelia caperata (L.) Hal form *caperata*	**5**	11			X	X			X		X	X
Hyperphyscia adglutinata (Flörke) H.Mayrhofer & Poelt	**5**	10	X			X	X				X	X
Hypogymnia physodes (L.) Nyl.	**4**	9	X						X	X		X
Lecanactis paterllaroides (Nyl.) Vain	**4**	12				X	X			X		X
Lecania naegelii (Hepp) Diederich et Van den Boom	**3**	9		X			X	X				
Lecanora chlarotera Nyl. subsp. *chlarotera*	**3**	7				X	X					X
Lecanora expallens Ach.	**3**	6	X		X							X
Lecanora horiza (Ach.) Linds.	**3**	3				X	X			X		
Lecanora siena B. de Lesd.	**2**	3		X		X						
Lecidella elaechroma (Ach.) M.Choisy	**2**	6			X		X					
Lecidella euphorea (Flörke) Hertel	**2**	7					X	X				
Lepra albescens (Huds.) Hafellner	**2**	6		X								X
Leprarea incana L. Ach.	**2**	3				X		X				
Parmelia sulcata Taylor s.l.	**0**	0										
Parmelia tiliacea (Hoffm.) Hale	**0**	0										
Phaeophyscia hizuta (Mereschk.) Essl.	**0**	0										
Phlyctis argena (Spreng.) Flot.	**2**	7	X					X				
Physcia adscendens (Fr.) H.Olivier	**6**	23	X		X	X	X		X		X	
Physcia stellaris (L.) Nyl.	**0**	0										
Physcia tenella (Scop.) DC.	**0**	0										
Pleurosticta acetabulum (Neck.) Elix & Lumbsch	**2**	2				X		X				
Ramalina farinacea (L.) Ach.	**0**	0										
Ramalina fraxinea (L.) Ach.	**0**	0										
Scytinium lichenoides (L.) Otálora, P.M.Jørg. & Wedin	**0**	**0**										

COMPARATIVE STUDY ANALYSIS OF THREE TILLAGE TECHNOLOGIES ON SOIL AND THE SOWING DEPTH OF DURUM WHEAT

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Abstract: *The study focused on the effect of different tillage technologies namely, direct seeding (DS), conventional tillage (CT) and simplified tillage (ST) on some soil parameters; water profile, parametric density and resistance of the soil, and also on the physiological and agronomic behavior of wheat cultivation in the semi-arid zone of eastern Algeria. The direct disc seeder has a positive effect on the water profile. The DS retains moisture better in the soil at the end of the cycle, which allowed for good grain filling. Also, the accumulation of organic matter, the apparent density, the penetrometer resistance, as well as the physiological and agronomic behavior (extension of the root system and the depth of sowing), as well as the grain yield are in favor of direct sowing compared to other techniques.*

Keywords: *Conservation agriculture; water profile, cereals, semi-arid, soil resistance, yield*

1. Introduction

In north Africa, natural resources are certainly diverse but they remain threatened by the effects of climate change. In order to maintain a minimum of agricultural production in this region, water management under semi-arid agro-ecological conditions remains an absolute necessity. Tillage can result in long-term degradation of soil structure, loss of organic matter, erosion and loss of biodiversity. several studies emphasize the economic, agronomic and environmental interest that characterize simplified farming techniques, especially direct seeding [1]. According to Arnal, [2], the primary goal of no-till is to conserve, enhance and use natural resources more efficiently through integrated soil, water, biological and inputs from external products. The ultimate goal is to establish a sustainable agriculture that does not degrade our resources, without renouncing to maintain production levels. No-till principles are: (I) a minimum soil disturbance, maintaining some of the residues of previous campaigns surface, (ii) adoption of crop rotations that ensure integrated management of weeds, diseases and pests, and (iii) better water productivity and thus a diversification of the production system [3].

In Algeria, despite natural constraints and the scarcity of resources essential for agricultural activity, agriculture has always been a main pole of sustainable creation of jobs and wealth. In recent decades, cultural practices have severely degraded ecosystems, including soils.

The main phenomena observed are: compaction, deterioration of the structure, reduction of organic matter, water and wind erosion [4]. To safeguard our resources, we must change the work mentality and look for new strategies in farming techniques. Maximizing the efficiency of soil water use, reducing soil erosion, increasing the productivity of biomass per unit of water used, and improving the conversion of vegetative biomass into economic output are the objectives sought in semi-arid areas. In fact, conservation agriculture has emerged as an alternative or complement to conventional agriculture [5]. Water conservation is an important parameter of soil quality. It is often a limiting factor in agricultural productivity. Several research works report that no-till improves soil water retention properties compared to the conventional technique [6; 7; 8;

9). The aim of our present work is to compare the effect of different tillage technologies, namely direct seeding (SD), the simplified cultivation techniques (TCS) and conventional work (TC) mainly on water use efficiency in grain under rainfed conditions, through the water balance and agricultural production in Durum wheat.

2. Materials and methods

The experimental plot is located on the farm at the experimental station of the Technical Institute of Field Crops (ITGC) in Sétif departement. The station belongs to the semi-arid stage with a mediterranean climate, clearly continental. This climate is characterized by a dry and hot summer, a cold and wet winter and a relatively dry spring with frequent late frosts. The dry season can extend over 4 to 5 months from march to september, with an early risk of sirocco [10]. The cumulative rainfall during the 2018/2019 agricultural campaign amounts to 346 mm. We can estimate that the rainfall distribution was good with regard to the physiological cycle of the cereal, especially at the beginning and end of the cycle.

The soil of the experimented site is moderately deep, its depth varies from 40 to 70 cm. It is located on a flat and stony surface, characterized by a fine silty-clayey texture. The rate of total limestone (22.3%), reveals that the soil is strongly calcareous, with a high rate of active limestone (9.02%), as confirmed by Laabad and *al*. [11]. The organic matter is relatively high in block with previous direct seeding (2.21%) compared to that of simplified tillage (TCS) and conventional tillage (TC), respectively: 2.14% and 1.96%. This can probably be due to the cumulative effect of organic matter over the past three years, when the experiment began, and the more pronounced mineralization in conventional work and simplified cultivation techniques.

The experimental design adopted is a single-factor block, with three repetitions (3 blocks). It has four levels: direct seeding (SD), with disc seeder (SDD) rated T1, tine seeder (SDT), rated T2, conventional tillage (TC), rated T3 and simplified cultivation technique (TCS) , denoted T4. A single variety (Bousselem: PMG= 39,4 g) in durum wheat as a strategic species.

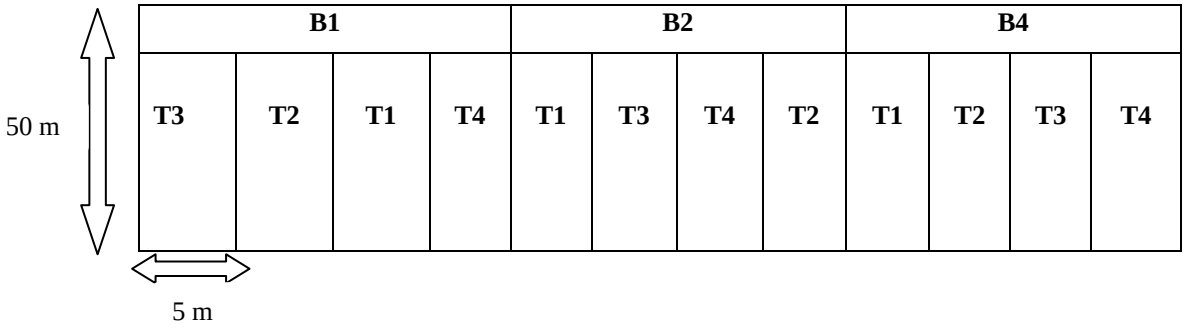


Fig. 1. *Diagram of the experimental device adopted*

Steps of soil preparation:

a) Direct seeding (SD): zero tillage.

b) Conventional tillage (TC): deep plowing of 30 cm using a disc plow, followed by a passage of the tine plow, a passage of cover-crop and a harrowing.

c) Simplified cultivation technique (TCS) or minimum labor (TM): a single pass of tine cultivator, followed by a pass of cover-crop, and harrowing.

2.1 Measured parameters

2.1.1 Soil humidity

Monitoring the water profile throughout the vegetative cycle is one of the main objectives of our work in fact, several soil moisture samples were taken throughout the vegetative cycle of the cereal, during the agricultural campaign, at two depths: 0-20cm, 20-40cm.

2.1.2. Penetrometer resistance (Rp)

Its measurement was carried out using a penetrometer whose operating mode consists of pushing the cone of the penetrometer into the ground and measuring the force to be applied. This effort, displayed on surface of the cone base defines the index of cone. Measurements are made at three depths (0-5cm, 5-10cm, and 10-15cm), with three replicates for each treatment as shown in Figure 1. Penetration resistance is one

way to determine bearing capacity soil load and the ease with which roots will work their way through the soil (important where agricultural, rural and civil engineering techniques are involved).

Rp (N/cm²) = reading on screen / cone surface

Fig. 2. *Representative photo of the penetrometer measurement*

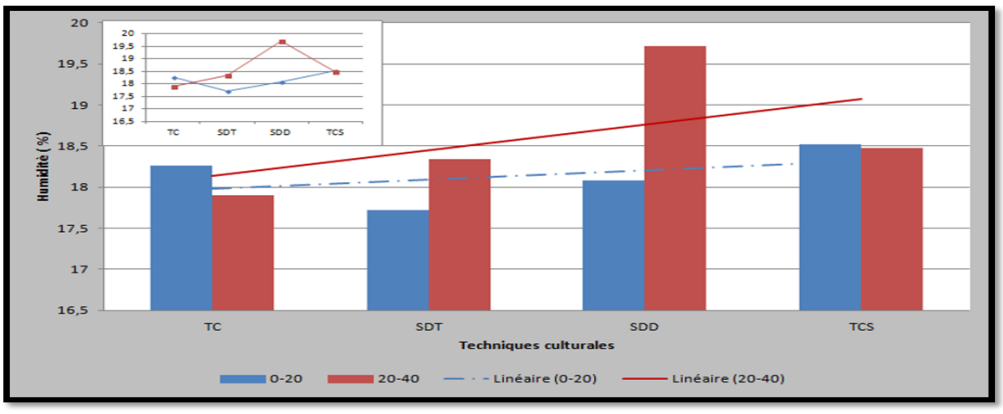
Deep sowing delays emergence and can even lead to the seeding death (and this all the more easily the seed smaller). It should be avoided, except in the case where you want to sow a cover crop early (possibly at the same time as the main crop) for reasons of accessibility to the plot, but where the emergence of this plant should not be too early to prevent it from competing with culture. However, this practice requires a good technical mastery of sowing, and can only be done with plants that can tolerate deep sowing.

3. Results and discussion

3.1 Soil humidity: Water profile in the soil

The monitoring of the evolution of the weight humidity of the soil in the four cropping technologies through the two depths P1: 0-20 cm and P2: 20-40 cm illustrated by the histograms of figure 3 show important variations according to the phases and physiological stages of the wheat crop. The cumulative humidity is higher in SDD followed by TCS, TC and SDT (fig. 3). This is mainly due to soil cover by organic matter. The organic matter allowed the infiltration of water by the ground cover effect. The TC prevents the evaporation of the soil following its opening soil.

By soil depth, the histograms and linear trend curves (fig. 3) show that the underlying part (20-40cm) accumulates more water (+0.47%) compared to the upper part (0- 20cm). The combination, soil depth and cultivation technique favors SD, TCS and TC. This clearly shows the interest of direct seeding in the accumulation of water in the underlying parts of the soil.



Legend: *SDD:* direct seeding with disc, *SDT:* direct seeding with tine, *TC:* conventional tillage, *TCS:* simplified tillage

Fig. 3. ***S****oil moisture content by cropping technique and soil depth (%)*

In relation to the crop cycle, soil moisture is linked to the cultivation technique adopted. At the surface (0-20cm), the SDD (disc) gave the emergence stage a relatively high humidity

compared to the lowest rate: +0.90%, followed by TCS (+0.71%), TC (+0.03%) and SDD (0%). In depth (20-40cm), the SDT (tooth) monopolizes the first place (+2.14%) is followed by the TCS (+1.08%), SDD (+0.52%), and in the CT. At the upstream stage, an increase in humidity levels in TCS at both depths (fig. 4 and 5). However, at the end of the vegetative cycle, essentially at the maturiy stage, in the two depths, the SDD followed by the SDT gave better results compared to the TCS and the TC respectively. This shows the interest of no-till (SD) in storing water at the end of the cycle.

The role of SD made it possible to create, maintain and preserve a good soil structure throughout the crop profile and to help maintain a good water profile [6 and 7]. This water profile would be the result of reduced evaporation and low water runoff due to the presence of crop residues on the surface and/or greater water retention, which reflects a high humidity rate [12]. In addition, the reduction in runoff is due to better protection of the soil surface against soil slaking.

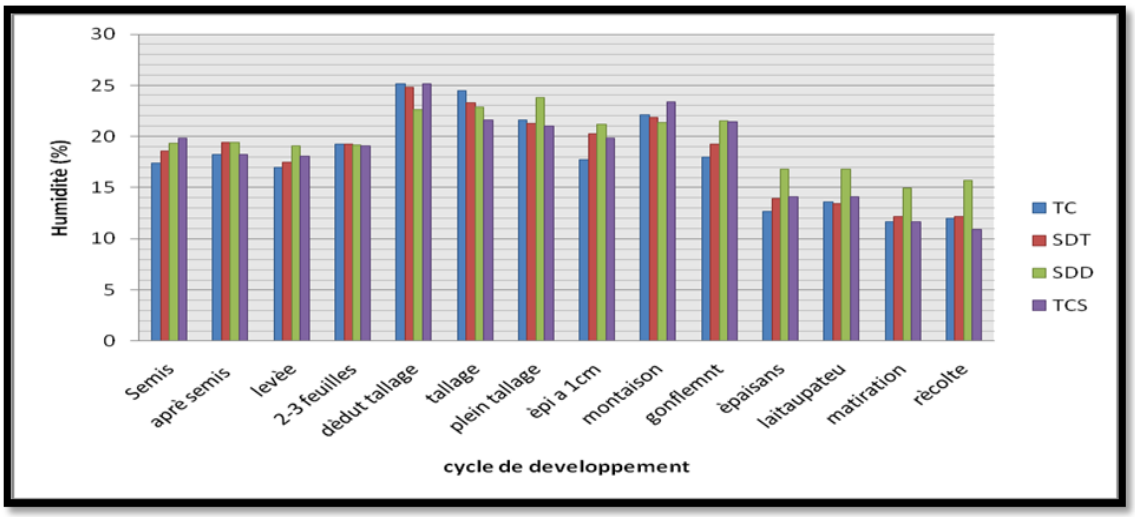


Fig. 4. *Evolution of humidity rate in the soil (depth 0-20 cm)*

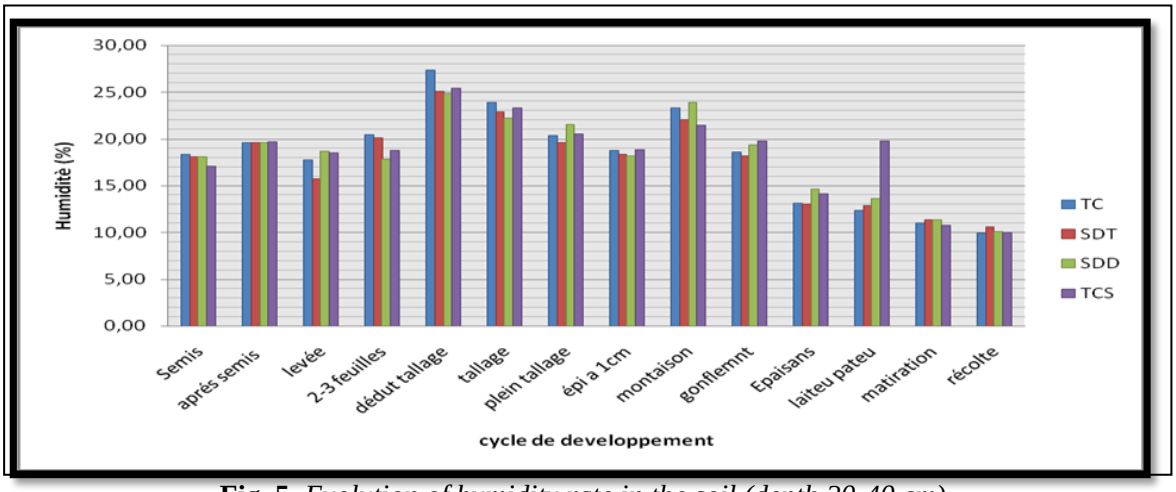


Fig. 5. *Evolution of humidity rate in the soil (depth 20-40 cm)*

3.2 Penetrometric resistance of the soil: R (N/cm²)

The technology separates two groups, (SDT, SDD) and (TCS, TC), fig.6. By soil depth, the penetrometric resistance of the soil progresses from bottom to top; 10-15 cm (730.33 N/cm²), 5-10 (672.50 N/cm²), and 0-5 cm (490.83 N/cm²) fig. 6, 7. The combination of tillage and soil depth shows three groups in the same trend:
Group A: 0-5 cm with SDD (620 N/cm²), SDT (546.7), followed by TC (426.7) and TCS (370 N/cm²).

Group B: 5-10 cm, SDT (756.7 N/cm²), SDD (690), followed by TCS (690) and TC (573.33N/cm²).

Group C: 10-15, with SDT (790 N/cm²), SDD (733.3), followed by TCS (718) and TC (680 N/cm²).

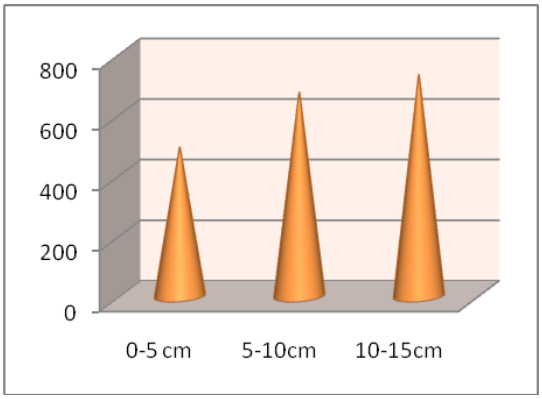


Fig. 6. *Effect of cultivation technology on penetrometer resistance by depth*

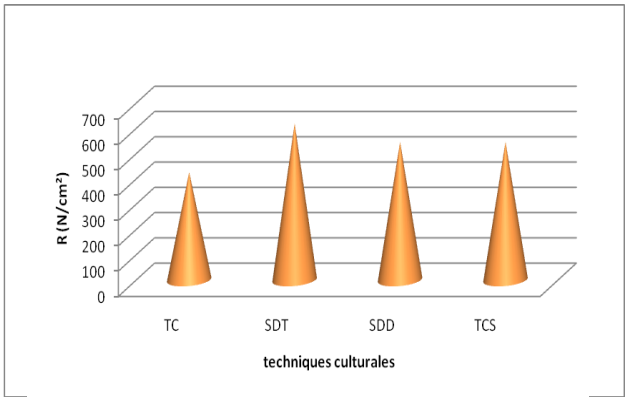
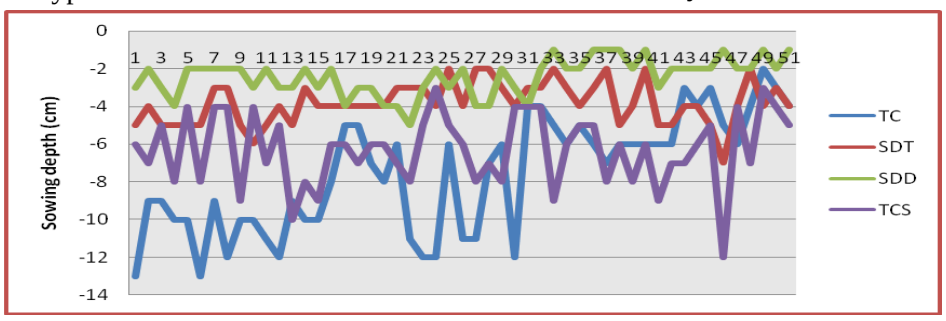


Fig. 7. *Effect of cultivation technology on penetrometer resistance by technology*

3.3 Sowing depth

Generally, the seeds are sown at a depth equal to one to three times their diameter. At this depth, adequate humidity and optimum temperature will accelerate their germination. Sowing too deep will compromise seedling emergence [13]. The sowing depth is one of success factors of the vegetative cycle of crops. Therefore, the seeding depth was measured at the emergence stage for the four treatments (SDD, SDT, TCS and TC). Remember that the sowing was carried out mechanically using a seed drill for the TC and TCS and a direct sowing drill for the SDD and SDT. Saying that the seeding depth is homogeneous for all the treatments, except this is not the case. The average trend in seeding depth is very varied. Depending on the tillage, it varies between 8 to 12 cm in simplified cultivation technique (TCS) and conventional tillage (TC). While in direct seeding (SD), the seeding depth varies between 3 to 5 cm depending on the type of seeder used and essentially the preparation of the seedbed [14]. Generally, the sowing depth depends on the stability of the planting organs in the soil. In conventional tillage (TC) and simplified cultivation technique (TCS), the soil is worked deeply and loosened well; which is explained by the measured sowing values (fig. 8). Burial organs penetrate each other deeply, however, in direct sowing (SD) where the soil is more or less compact, the seeds are planted at the level of the first soil centimeters. Often, deep sowing leads to late germination and emergence losses. In SD, the emergence is more homogeneous and the seeding depth is more regular, whereas in the conventional technique the losses at emergence are very significant [15]. In addition, in direct seeding (SD), the seeding depth is slightly higher using the tine seeder (SDD) compared to the disc seeder (SDT). Tine seeders have the ability to spread residue and place seed deeper in the presence of fine soil compared to disc seeders. This is confirmed by Merabet [16, 17].



Legend: SDT: direct tine seeding, SDD: direct disc seeding TCS: simplified cultivation technique, TC: conventional tillage.

Fig. 8. *Effect of cultivation technique on seeding depth*

Conclusions

Soil humidity variation between beginning and end of vegetative cycle, with direct seeding profile, shows that: (i) Direct seeding can be a way of managing water resources by saving water, especially at cycle vegetatif end, especially in drought conditions, (ii) In conventional work, plowing influences soil structural stability; this becomes more permeable and permit acceleration of water evaporation. Overall, underlying soil part (20-40cm) retains more water than surface layer (0-20cm). Except at direct seeding and planting stage, humidity is higher at surface because soil is not yet well engorged with water in case of no tillage. At end of cycle, horizon 20-40cm accumulates more water respectively for direct seeding, simplified cultivation and conventional work. The results show a trend towards better grain production for no-tillage and also in simplified cultivation and conventional work. For water balance, direct seeding takes up first place compared to conventional work and simplified cultural technique. Finally, cereals grain's yield in semi-arid and rainfed areas expressed by water use efficiency. This efficiency is determined by choise combination of tillage technical and crop rotation. Conservation agriculture, including direct seeding can be an alternative for a better water efficiency use.

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RESEARCH ON THE IMPORTANCE OF WOOD BIOMASS IN ENVIRONMENTAL PROTECTION

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Abstract: *Romania owns 6.592 million hectares, which represents 27% of the territorial area. One inhabitant owns 0.3 hectares of the entire forest fund. Failure to rationally exploit the forest fund can lead to environmental pollution. 11000000 m^3/year are cleared annually, of which 0.1 is waste, so 11000 m^3/year results. By drying and processing the sawdust, briquettes can be obtained which reduce the pollution of the environment from the point of view an organic fuel. Biomass occupies the largest percentage (47%) of all renewable energy sources. Biomass can serve as an essential alternative for renewable energy production as well as a large investment. The importance of using biomass in the producing of biofuels has signaled the increase of areas cultivated with oily olants (rapeseed). Animal manure is used to produce biofuels.*

Keywords: *calorimetric bomb, wood biomass, calorific value, composite*

1. Introduction

The great challenge of the planet in the field of energy is the orientation towards alternative energy production systems. Renewable energy research is likely to accelerate the process of producing green electricity for consumers. Energy consumption is forecast by 2025 of 34.9 Mtoe. From the point of view of the forest area, the richest regions are Suceava 647 mii m^3, Harghita 206.5 mii m^3, Neamt 175 mii m^3, Bacau 132 mii m^3.

Brasov county is located on the place of the poorest areas in terms of forest vegetation 89 mii m^3, and the poorest an the countries in the south of the country (Constanta, Tulcea, Galati). Wood biomass includes a wide variety of organic sources of both wood and waste. Biomass includes renewable materials of organic nature, including vegetation (agricultural crops for food use, trees and crops for energy production, industrial plants) as well as waste from agriculture, fish, and forestry. Table 1 shows leaf biomass in deciduous and softwoods.

Table 1. *Leaf biomass in deciduous and softwoods*

Wood species	Foliar biomass (t/ha)
Fagus sylvatica	2.9-5.1
Quercus robur	4.4-5.4
Picea abies	18.5
Abies alba	22

An important amount of biomass is the residues of agricultural crops (cereal straw). An important renewable energy resource is waste that contains significant amounts of organic material (paper, cardboard, waste wood, waste garden). An important source of biofuel production is plant exploitation.

At present plants with energy potential are known, which accumulate oils (oilseeds) in various anatomical elements, other plants accumulate carbohydrates (corn, sugar came, sugar beet) from which they can obtain ethanol or methanol used as biofuel.

Vegetable fats have an energy value higher than 9000 cal/mol gr, almost double that produced by carbohydrates, over 4000 cal/mol gr.

Biogas obtained from anaerobic transformation can be produced from a variety of types of biomass. The main primary source is manure from animal farms, cattle and pig farms. If all the manure from Romanian farms were collected 50 biogas plants could be built. The biogas produced daily by such a station is 1200-3600 m^3/day or 2400 kWh of electricity/day or

700000 kWh/year of electricity. The heat transfer represents 4200 kWh/day or 1600000 kWh/year.

2. Materials and method

The equipment used to determine the calorific value of wood biomass is the XRY-1C explosive combustion calorimeter, produced by Shanghai Changji Geological Instrument in China.

Before performing the actual test, the calorimeter bomb is calibrated with benzoic acid, using benzoic acid with a known calorific value (26463 kJ/kg).

The process of determining the calorific value of the wood material refers first of all to the preparation of the raw material and the installation, then to the actual determination and finally to the obtaining of the final result.

The preparation of the installation refers to the verification of the quantity of water in the calorimeter, of the agitator A of the water in the tank, of the computer software C, of the external thermometer of the calorimeter T and the gas pressure level in the oxygen cylinder B0. The test sample 1 is tied to the cotton thread 2 and placed in the crucible of the bomb 3. Connect the spiral nickel wire 4 to the sample and the cotton wire, then position the protective cover 5 correctly.

The crucible is connected to the cover of the calorimeter pump 6 by 2 electrodes 7 and 8, which continue with the electrical coupling wires of the calorimetric pump 9 and 10. By screwing the pump cap, the pump 11 is connected through the nozzle 12 to the oxygen cylinder, introducing 30 atmospheres. Insert the pump in the calorimeter of the C_u equipment, connect the 2 electrical wires, close the cover of the calorimeter and insert the thermometer T to determine the temperature (Fig.1).

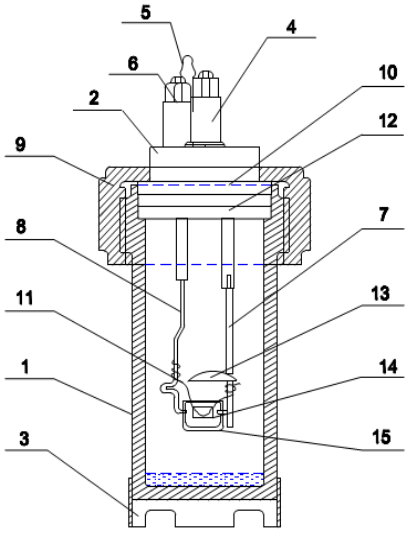

Fig. 1. *Bomb calorimeter*

The test contains three different periods, respectively:

- The initial period (fore), which aims to determine the temperature variations, of the water in the calorimeter, due to the exchange of heat with the outside before burning. During this period, usually 5 minutes, the precision thermocuple temperature is displayed and read minute by minute (Fig.2).
- The main period ("main") begins with the ignition of the sample and has as a consequence the increase of the water temperature in the calorimetric vessel, due to the burning of the wood particle and the emonation of heat.
- The final period ("after") aims to determine the average temperature variation of the water in the calorimeter due to the heat exchange with the outside, after combustion.

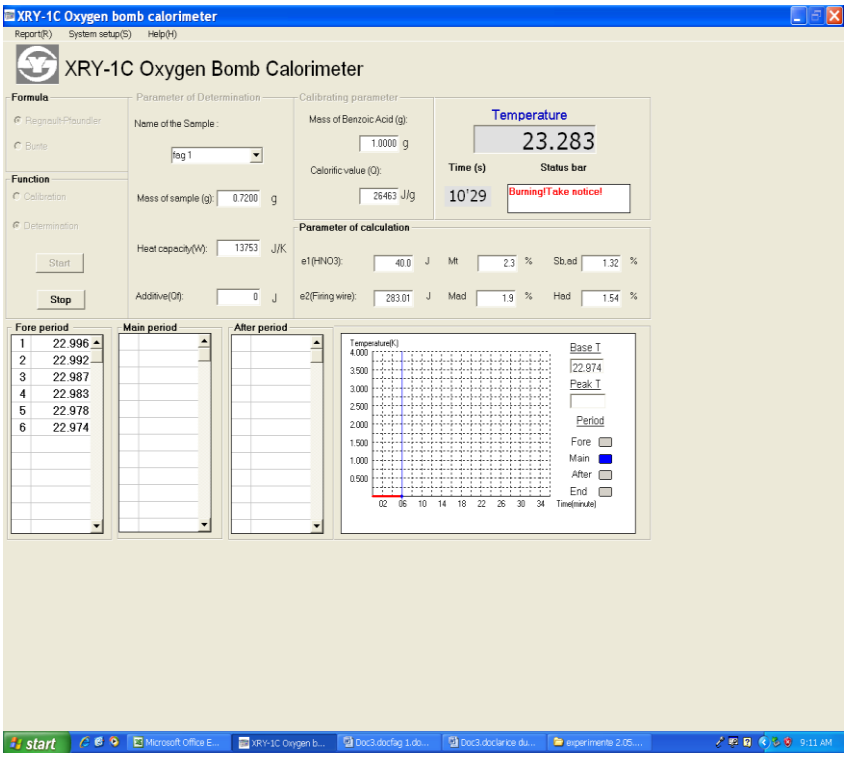

Fig. 2. *Description of the process to assess the caloric power*

For the PAL (chipboard) with thickness 18 mm, at U= 0%, m= 0.7970 g, higher caloric power= 19196 kJ/kg, lower caloric power= 18555 kJ/kg, density= 0.724 g/cm^3, U= 10%, m= 0.870 g, higher caloric power= 16885 kJ/kg, lower caloric power= 16245 kJ/kg, density= 0.791 g/cm^3, U= 20%, m= 1 g/cm^3, higher caloric power= 14895 kJ/kg, lower caloric power= 13615 kJ/kg, density= 0.917 g/cm^3, U=50%, m= 0.835 g, higher caloric power= 8925 kJ/kg, lower caloric power= 5725 kJ/kg, density = 0.835 g/cm^3.

The variation of the calorific power for PAL with thickness 18 mm is presented in Fig. 3.

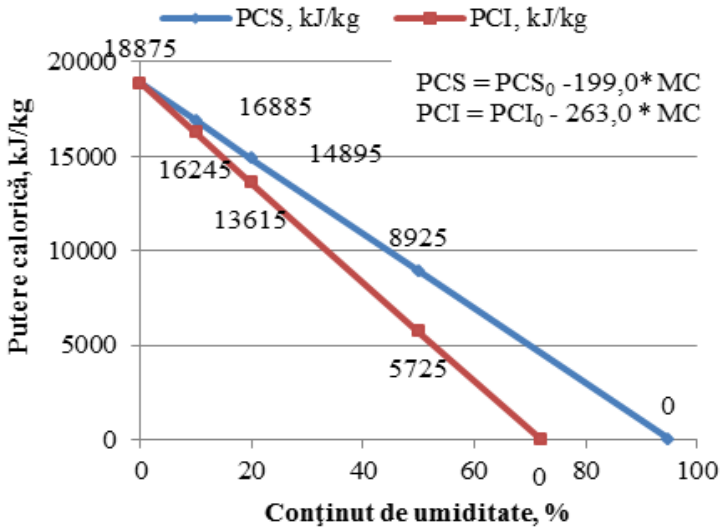

Fig. 3. *The variation of the calorific power for PAL with thickness 18 mm*

For the PAL (chipboard), at U= 0%, m= 0.7090 g, higher caloric power= 18524 kJ/kg, lower caloric power= 18228 kJ/kg, density= 0.644 g/cm^3, U= 10%, m= 0.5940 g, higher caloric power= 16184 kJ/kg, lower caloric power= 15756 kJ/kg, density= 0.540 g/cm^3, U=

20%, m= 0.7090 g/cm^3, higher caloric power= 13844 kJ/kg, lower caloric power= 12988 kJ/kg, density= 0.642 g/cm^3, U=50%, m= 0.6890 g, higher caloric power= 6824 kJ/kg, lower caloric power= 4684 kJ/kg, density = 0.620 g/cm^3.

The variation of the calorific power for PAL with thickness 3 mm is presented in Fig. 4.

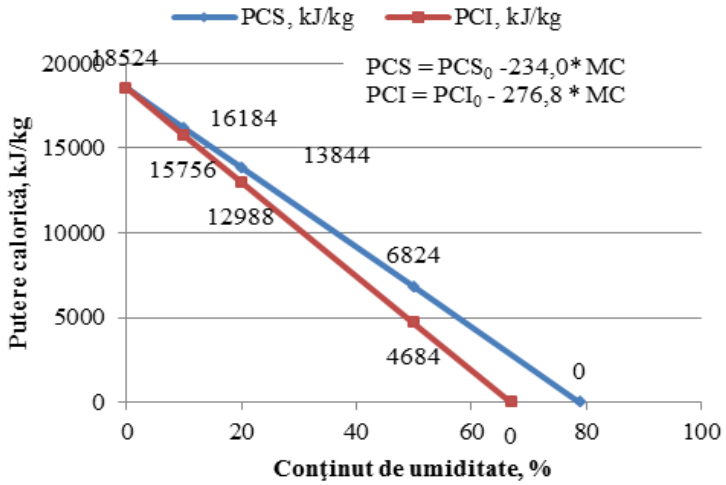

Fig. 4. *The variation of the calorific power for PAL with thickness 3 mm*

3. Conclusions

Wood biomass is an alternative in energy production. This is evidenced by the amount of wood left over from wood processing.

Of the fuel available energy potential only 1.7 TW/year is currently used.

Household consumers can get lower maintenance costs by using wood biomass.

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INSECTICIDAL ACTIVITY OF THREE *SOLANACEAE* PLANTS (*SOLANUM NIGRUM*, *NICOTIANA GLAUCA* AND *ATROPA BELLADONA*) ON GERMAN COCKROACHES (*BLATTELLA GERMANICA*)

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Abstract: *Cockroaches are dictyopteran insects that appeared on earth more than 440 million years ago, with more than 4440 species of cockroaches that are known to date, many of which are considered pests and cause many problems. health issues for humans, such as allergies.*

The fight against cockroaches is one of the current problems that the scientific world is trying to solve, in the face of the chemicals widely used today and which cause the development of resistance in the treated insects in addition to their impact on the environment. In the present study we tested the toxicity of the aqueous extract of three plants of Solanaceae (Solanum nigrum , Nicotiana glauca and Atropa balladona) with regard to the adults of Blattella germanica , where we marked a high mortality rate which can reaching 90% of the population after 30 days of exposure to a dose of 1000 µg / ml of the Solanum nigrum extract , the results give a toxic effect on cockroaches determined at different lethal and sublethal times (TL50% and TL 90 %).

Keywords: *Cockroaches, Blattella germanica , Solanum nigrum , Nicotiana glauca , Atropa balladona , Toxic effect.*

1. Introduction

Cockroaches are insects of tropical origin introduced involuntarily into human habitats, and some of them have become urban animal species. They are installed in all types of housing such as hospitals, restaurants, food shops and private apartments (Nicole *et al.*, 1997).

Domestic cockroach species are known to be harmful insect vectors of pathogens and also contaminate food products with their characteristic odor and their defecations (Grandcolas, 1998).

Cockroaches move freely, they feed on human and animal waste or can come into contact with them during their many movements in sewers, latrines and pipes. Cockroaches from outside will potentially be able to contaminate food with bacteria responsible for food poisoning (Hedjouli, 2022).

The faeces, saliva, bodily secretions, molts and dead bodies of cockroaches are sources of powerful allergens. They will be able to cause skin reactions, topical dermatitis, itching, swelling of the eyelids, rhinitis, but especially asthma. As early as the 1940s, skin rash and asthma phenomena could be attributed to cockroach allergens (Mourier, 2014).

Among the species of cockroaches, *Blattelle germanica* is a dictyopteran insect of the

Blattellidae family (Guillaumin *et al*., 1969) has heterometabolic development, larvae and adults of this species are omnivorous (Pedigo, 1989) constitute an important problem in terms of hygiene and human health (Tine, 2013). They can also vector several human bacterial diseases (Ash and Greenberg 1980). The German cockroach *B. germanica* has a high reproductive potential (Willis *et al.,* 1958) and an ability to build large infectious populations (Nejati *et al.,* 2012).

Conventional chemical insecticides, mainly used for decades, have led not only to environmental pollution, but also to the appearance of insect resistance phenomena. It is imperative to consider the development of more specific insecticides, non-toxic to non-target organisms, biodegradable and less likely to cause resistance in target species (Saxena, 1988). In this axis, we tested the effect of the aqueous extract of three plants grouped in the family of *solanaceae* namely *Solanum nigrum* , *Nicotiana* glauca and *Atropa belladona* on adults of *Blattella germanica.*

2. Materials and methods

2.1. Presentation of the harmful insect

Blattella germanica (*B. germanica*) is a predominant domestic cockroach (Miller and Koehle, 2003), cosmopolitan (Gordon, 1996), oviparous and with heterometabolic development (Guillaumin *et para.* , 1969). It represents a potential vector for diseases such as dysentery, gastroenteritis, typhoid fever and poliomyelitis (Durier and Rivault, 2003).

2.2. Breeding

The cockroaches are placed in plastic boxes with mesh openings on the sides and containing egg cells for shelter. Cockroaches are fed with biscuits and drenched with cotton soaked in water. Rearing is maintained at a temperature of 23 ± 2°C, a relative humidity of (50-55%) and a photoperiod of 12 hours (Appel and Tanley, 2000).

2.3. Presentation of the insecticidal plants studied

Solanum nigrum (*S. nigrum*) is an annual plant, growing as weeds in cultivated fields or under trees, the plant was collected in M'sila (Algeria) in 2017 .

Nicotiana glauca (*N. glauca*) is a perennial plant that grows in semi-arid and humid regions, the plant was harvested in M'sila (Algeria) in 2019.

Atropa belladona (*A. belladona*) is a toxic plant grows in forests, this plant was harvested in Jijel (Algeria) in 2021.

All the plants used in this study were collected and authenticated by the botanist Pr. Rebbas Khellaf from the University of M'sila.

2.4. Preparation of extracts (by decoction)

To prepare the aqueous extracts of the three plants, we weighed the fresh leaves of each one of the latter, namely (*S. nigrum* , *N. glauca* and *A. belladona*), which were soaked in distilled water and allowed to boil over a benzene nozzle at an average temperature. The mixture obtained is filtered using filter paper (Belkhiri, 2022).

2.5. Toxicity test

Young adults (male and female) of cockroaches (*B. germanica*) are isolated and grouped by 10 individuals in three repetitions in boxes (13 x 11 x 5 cm) containing dog food (food) and a tube of water with added a concentration of the aqueous extract and the control batches are watered with pure water. The same test applied for the three plants tested.

The experiment is monitored for a month, where the number of dead individuals is observed daily in order to determine concentrations and lethal times (Habbachi, 2013).

The concentrations of the extracts tested and the exposure times of the cockroaches are illustrated in Table 1, we chose two concentrations for each plant (500 and 1000 µg/ml for *S. nigrum* , 1000 and 1500 µg/ml for *N. glauca* while 35 and 70 µg/ml are the doses tested for *A. belladona*), and monitoring is done for 2.15 and 30 days for *S. nigrum* and *N. glauca* and for 5, 15 and 30 days for *A. belladona* .

Table 1. *Concentrations C (µg/ml) of aqueous extracts tested and exposure times T (days) of cockroaches in the present study*

Plant species	Concentration Applied (µg/ml)		Exposure time (days)		
	C1	C2	T1	T2	T3
S. nigrum	500	1000	2	15	30
N.glauca	1000	1500	2	15	30
A. belladona	35	70	5	15	30

2.6. Statistical analysis of data

With regard to the results obtained for the toxicological study, we calculated according to the mathematical procedures of Finney (1971), the lethal times (TL50% and TL90%) for each of the bio-insecticides used.

3. Results

3.1. Effect of *S. Nigrum* on *B. Germanica mortality*

Figure 1 summarizes the different mortality rates of *B. germanica* recorded after 2, 15 and 30th days of exposure to two concentrations (500 µg/ml and 1000 µg/ml) of *S. nigrum* . After the first 15 days of exposure we observed a low mortality which can reach 33.33% for the low concentration and 56.66% for the high dose. After 30 days of treatment, the mortality rates increase for the two concentrations and reach the values of 66.66% and 90% respectively.

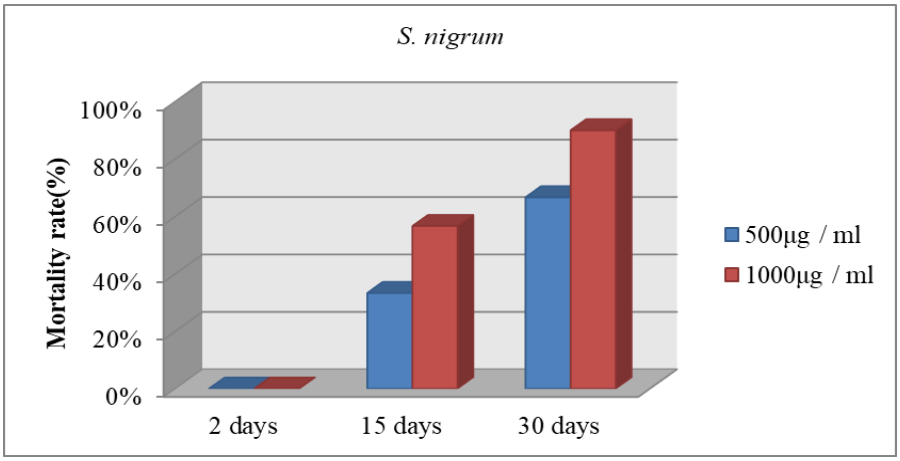

Fig. 1. *Corrected mortality rate of B. Germanica treated with S. Nigrum*

3.2. Effect of N. Glauca on B. Germanica mortality

The results illustrated in Figure 2 show that adults of *B. germanica* are sensitive to the extract of *N. glauca* , this sensitivity is reflected in high mortality rates recorded after 30 days of monitoring, of which we marked 70 % mortality when using a dose of 1000 µg/ml of the extract and 86.87% for 1500 µg/ml of the latter.

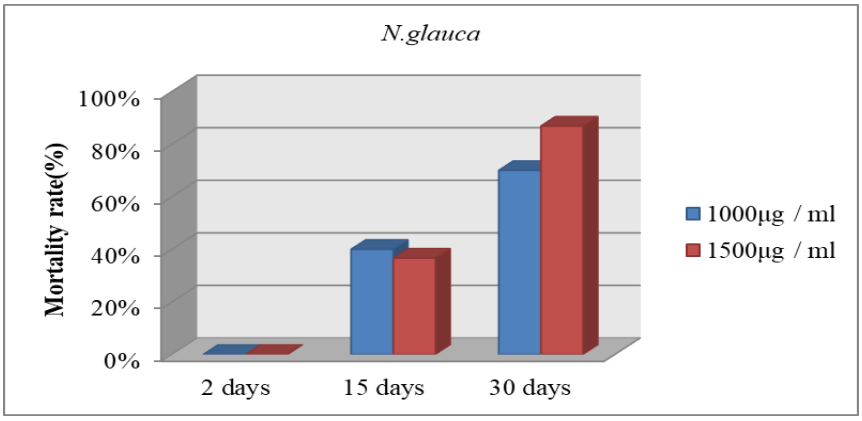

Fig. 2. *Corrected mortality rate of B. germanica treated with N. glauca*

3.3. Effect of *A. Belladona* on *B. Germanica mortality*

The use of the aqueous extract of *A. belladona* against the adults of *B. germanica* causes a mortality rate which varies between 3.35% and 26.7% depending on the concentrations and the exposure times. The application of the low concentration (35 µg/ml) induces a mortality rate of 3.35% after 5 days of exposure while the high concentration (70 µg/ml) shows a mortality rate of 5% after 5 days and 23.35% at 30 days (Fig.3).

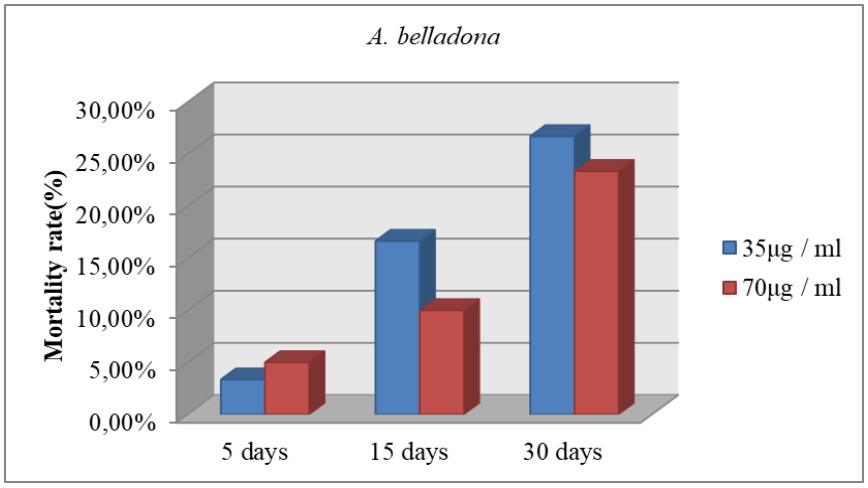

Fig. 3. *Corrected mortality rate of B. Germanica treated with A. Belladona*

4. Toxicological parameters

The results of Table 2 show that the use of a concentration of 500 µg / ml of the extract of *S. nigrum* causes the mortality of 50% of the cockroach populations after 20.89 days of treatment and 90% after 69.18 days of exposure. While the high dose (1000 µg / ml) causes mortalities of 50% after 12.02 days of follow-up and 90% after 31.62 days.

Concerning the extract of *N. glauca* we noticed that the low concentration (1000 µg/ml) can kill 50% of *B. germanica adults* after 18.62 days of treatment, the same percentage can die after 16.21 days if a high dose (1500 µg/ml) is used. On the other hand, to eliminate 90% of the adults of the same species with the use of the two concentrations (1000 µg/ml and 1500 µg/ml) we need 83.17 and 38.90 days respectively (Tab.2).

The results also show that the use of 35 µg / ml of the aqueous extract of *A. belladona* generates after 0.14 days the mortality of 50% of the adults of *B. germanica* , and 70 µg / ml of the same product can eradicate 90 % of the cockroach population after 14 days of exposure (Tab.2).

Table 2. *The toxicological parameters of the insecticidal plants used*

Plants tested	Concentrations (µg/ml)	Regressions	TL50% (Days)	TL90% (Days)
S. nigrum	500	Y=1,72+2,47x (R^2=0,48)	20.89	69.18
	1000	Y=1,66+3,07x (R^2=0,98)	12.02	31.62
N.glauca	1000	Y=2,52+1,95x (R^2=0,90)	18.62	83.17
	1500	Y=0,84+3,41x (R^2=0,88)	16.21	38.90
A. belladona	35	Y=-3,79+4,60x (R^2=0,62)	0.14	0.11
	70	Y=2,54+0,93x (R^2=0,97)	14	55

5. Discussions

The excessive and repeated application of conventional chemical insecticides has caused a phenomenon of resistance to appear in cockroaches and particularly in *B. germanica (Valles et al. al.*, 2000).

The use of plant extracts as an insecticide has been known for a long time, in fact pyrethrum, nicotine and rotenone are already identified as insect control agents, in more recent works the insecticidal properties of certain plants have been tested. on insect larvae (Crosby, 1996).

According to (Fournier, 2003) the aqueous extracts, powders and essential oils of plants contain molecules with insecticidal properties.

The Solanaceae family is one of the largest plant families, with nearly a hundred genera comprising over 2,500 species. Members of the family are scattered across all continents, in both tropical and temperate climates. It is a cosmopolitan family, composed of grasses, bushes and shrubs and which includes medicinal and/or toxic plants, many food and ornamental species. The diversity of the family from a chemical point of view is significant and

formidable poisons are produced (Hammiche *et al.*, 2013).

In this study, we tested the effect of aqueous extract of *S. nigrum, N. glauca* and *A. belladona on* adult mortality of *B. germanica* , the results show that there is a positive correlation between the rates of mortality, the concentration used and the exposure time.

Solanum is a rich source for several classes of compounds such as alkaloids (Emmanuel *and al* ., 2006), steroids (Ferro *and al* ., 2005) and phenolic compounds which enters the pharmaco-chemical industry (El-Sayed and Hassan, 2006).

Nicotine is also the most effective insecticide against aphids, whose mortality in its presence sorrels between 98 and 100%. It also acts on young scale insects and many sucking insects such as psyllids and leafhoppers (Zahaf, 2016).

For its part, belladonna is a deadly poison for humans as for animals, its toxicity has been confirmed on mice, rabbits and hares (Michel, 2001).

Conclusions

In this work, we demonstrated the efficacy of aqueous extract of *S. nigrum* , *N. glauca* and *A. belladona* as bio-insecticides on adult mortality of *B. germanica* . Mortality rates are positively correlated with the concentrations used and the duration of treatment. Our hope is that in the near future, we will be able to reduce chemical treatments against domestic cockroaches which may have developed resistance to the latter, for which the valorization of extracts from other plants in integrated pest management is then hoped.

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UTILISATION OF DIFERENT *ROSA CANINA* L EXTRACTS FOR OBTAINING ICE CREAM WITHOUT LACTOSE

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Abstract: *The rosehip fruits extracts, (rich in vitamin C and other valuables compounds) could added numerous nutritional and therapeutic advantages to ice cream - a dessert appreciated by the consumers having problems regarding the lactose digestion, but also by those who prefer frozen sweets. In this study, three experimental variants of ice cream were prepared using extracts of Rosa canina L fruits (15% and 20%) and different receipt containing almond milk instead of milk products. The ice cream samples prepared using 15% rosehip extracts (added in the mix) and 15% raspberry fruits had the best values for all physic chemical parameters tested, especially for their level of vitamin C. This variant was the most appreciated for all the parameters of sensory analysis evaluated (appearance, taste, flavor, body/texture and overall acceptability). There were no differences between the ice cream quality parameters tested after 0 and 40 days stage period.*

Keywords: *rosehip extracts, ice cream, vitamin C, product without lactose.*

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1. Introduction

Currently, the scientific world is increasingly concerned with improving the quality of life through a rational and harmless diet. The subject of this study is found in this area of concern and refers to the valorization of rosehip extracts and the use of almond milk (rarely used in the ”sweets” industry, despite its rich content in nutrients and vitamins) in order to obtain new varieties of ice cream intended for the people with intolerance to lactose.

Rosehip fruits (*Rosa canina* L.) were chosen because these valuable vegetable sources could contribute to obtaining functional foods, due to the additional supply of minerals and antioxidants (e.g. vitamin C), with a major role in maintaining the health of consumers. In addition to vitamin C, rosehip fruits content carbohydrates, organic acids, pectines, flavonoids, tannins, carotenoides, fatty acids, vitamins (K, B1, B2, PP, E) and minerals (Demir, 2001; Ercisli, 2007). Ercisli and Esitken (2004) report a higher vitamin C content in *Rosa canina* fruits compared to citrus fruits. Ziegler et al. (1986) specified that rosehip fruits contain 30-1300mg/100g of vitamin C, stating that this vegetable source is particularly rich in this valuable compound for human health. The metabolism of the people is increasingly attacked by polluting factors, environmental factors and multiple dangers triggered by increasingly aggressive pathogens. Due to the high content of antioxidants (especially L ascorbic acid), rose hips fruits and their extracts are an excellent natural ingredient which can help to reduce fatigue, physical exhaustion and improve immunity of the consumers. (Ocksook et al., 2007; Orhan et al., 2009)

Ice cream is a frozen dairy product made by suitable blending and processing of cream and other products, together with sugar and flavor, with or without stabilizer or color, and with the incorporation of air during the freezing process (Sukumar, 1980). Therefore, ice cream represents, a complex dispersed system in which emulsions, foams, gels coexist; it consists of a frozen aqueous phase containing fat droplets, ice crystals and small air cells.

The aim of this study was to obtain and test some fortified products - ice cream variants with functional valences due to the addition of different extracts of rosehip fresh fruits (rich in vitamins, minerals and nutrients).

2. Material and method

2.1. Preparation and storage of ice cream

The ingredients used for ice cream preparation (Table 1) were purchased from local market. After various preliminary trials with different extracts

and combinations of ingredients and their sensory evaluation by a panel of judges, there was chosen the variants presented in table 1. General aspects of some of these variants are presented in fig. 1.

Weighed dry ice cream ingredients were mixed with the liquid material by constant mechanical stirring.

Table 1. *Ice cream variants obtained using rosehip extracts and ingredients without lactose*

Ingredient used in the recipe	Ice cream variants		
	Variant V1 Ice cream with rosehip extracts added in the mix	Variant V2 Ice cream with rosehip extracts and raspberry	Variant V3 Ice cream with rosehip extracts added as topping
Almond milk non sugar	510	510	510
Almod paste	135	135	135
Water	113	113	113
Sel	1	1	1
Sucrose	70	70	70
Dextrose	126	126	126
Inulin	40	40	40
Stabilizer	5	5	5
Raspberry	-	150	-
Rosehip extracts	200	150	100

Fig.1. *Aspects regarding the ice cream experimental variants obtained using rosehip extracts*

Weighed dry ice cream ingredients were mixed with the liquid material by constant mechanical stirring. The prepared ice cream mix was pasteurized at 72°C for 30 min and then homogenized by using high speed homogenizer. After homogenization, the material was kept for 5 to 6 h for ageing at 4°C.

The ice cream was frozen at a temperature of −1°C to −9°C along with the whipping of air into the mix by agitation in hand operated ice cream freezer (machine). The ready ice cream was filled in disposable pots and kept in the hardening unit at -30°C for 24 h. The prepared ice cream was stored at −25°C in a freezer for 40 days.

2.1. Physico-chemical analysis

Ice cream samples were evaluated at 0, 20 and 40 days of storage for physico-chemical and sensory characteristics.

Moisture and acidity were determined according to the method described by Kirk and Sawyer (1991). Protein, ash, total solids and pH were calculated according to AOAC (1990). Gerber method (Davide, 1977) was applied for fat determination.

2.2. Sensory evaluation

The sensory evaluation was carried out using 9-point hedonic scale for appearance, taste, flavor, body/texture and overall acceptability (Larmond, 1977).

2.3. Vitamin C determination

Determination of the L ascorbic acid content wascarried out using an enzymatic method(L-ascorbic acid test kit, Megazyme Ltd., Sigma Aldrich, USA, cod product MAK074) following the instructions of the manufacturer. The results were expressed in mg vitamin C/100g product.

2.4. Microbiological analysis

The bacterium *Listeria monocytogenes* is resistant to very low temperatures. This is the raison because the presence/absence of this pathogen is important to determine in accordance with the previsions of EN ISO 11290-1,2. The analysis was carried out using the method described by Puchianu (2014.)

2.5. Statistical analysis

Data were analyzed by ANOVA and Duncan's Multiple Range Test and scored as significant if P<0.05 (IBM SPSS Statistics software).

3. Results and discussion

3.1. Physico-chemical parameters of the ice cream samples

The physico-chemical analysis of the ice cream revealed that moisture, total solids, pH and acidity were significantly affected by ice cream samples having different addition of rosehip extracts and different receipts (Table 2) as well as the storage period (Table 3). However, the storage had non significant effects on fat, protein and ash contents of ice cream.

The highest values for all indicators excepting the pH were noted in sample containing 15% rosehip extracts and raspberry fruits (Table 2).

Moisture contents also showed a decreasing trend throughout the 40 days storage resulting in an inverse effect on total solids (Table 2&3).

The pH has direct influence on the flavor perception of the dairy products (Hegenbert, 1991). The results showed that there was a decrease in pH throughout the storage (Table 2&3). This decrease was correlated with the increase in acidity, possibly due to the conversion of some organic acid during storage. However, there were non significant differences in fat, protein and ash contents of ice cream samples (Table 2&3), and also no significant change was noted in all these parameters during storage (Table 2&3).

Table 2. *Physico chemical parameters of the ice cream variants after 0 days storage period*

Physico chemical parameters*	Variant of ice cream tested after 0 days		
	V1	V2	V3
Moisture (%)	63.35b	64.42a	63.01c
Total Solids (%)	35.88b	36.91a	33.29c
Fat (%)	8,12a	8,20a	8,06a
Protein (%)	3,23b	3,38a	3,17a
pH	5.2b	4.9b	6.3a
Acidity (%)	0.198a	0.202a	0.182b
Ash (%)	0.58a	0.59a	0.57a

**Data are means of three experiments. Values with different letter differ significantly by Duncan test (p<0.05).*

Table 3. *Physico chemical parameters of the ice cream variants after 40 days storage period*

Physico chemical parameters*	Variant of ice cream tested after 40 days		
	V1	V2	V3
Moisture (%)	61.50b	62.57a	60.09c
Total Solids (%)	36.08a	37.13b	34.72c
Fat (%)	8,13a	8,22a	8,08a
Protein (%)	3,23b	3,38a	3,17a
pH	4.5b	3.6b	5.0a
Acidity (%)	0.212b	0.230a	0.192b
Ash (%)	0.58a	0.59a	0.57a

**Data are means of three experiments. Values with different letter differ significantly by Duncan test (p<0.05).*

3.2. Sensory evaluation of ice cream

Ice cream samples were evaluated for appearance, taste, flavor, body/texture and overall acceptability, following the 9-point hedonic scale. All the sensory parameters were significantly affected by ice cream samples (Table 4). The highest scores were awarded to the ice cream sample variant V2 containing 15% rosehip extracts and 15% raspberry fruits followed by the ice cream containing 20% rosehip extracts added in the mix. While ice cream samples containing the rosehip extracts used as topping got the minimum scores. During storage, deterioration occurred in all the samples. However, overall effect of storage was non significant.

Table 4. *Sensory analysis of ice cream variants*

Sensory parameters	Variant of ice cream tested after 0 days		
	V1	V2	V3
Appearance	7.50b	7.96a	7.04c
Taste	7.42b	7.86a	7.20c
Flavour	7.72b	7.94a	7.72b
Body texture	7.70ab	7.96a	7.46b
Overall acceptability	7.34b	7.70a	7.28b

**Data are means of three experiments. Values with different letter differ significantly by Duncan test ($p<0.05$).*

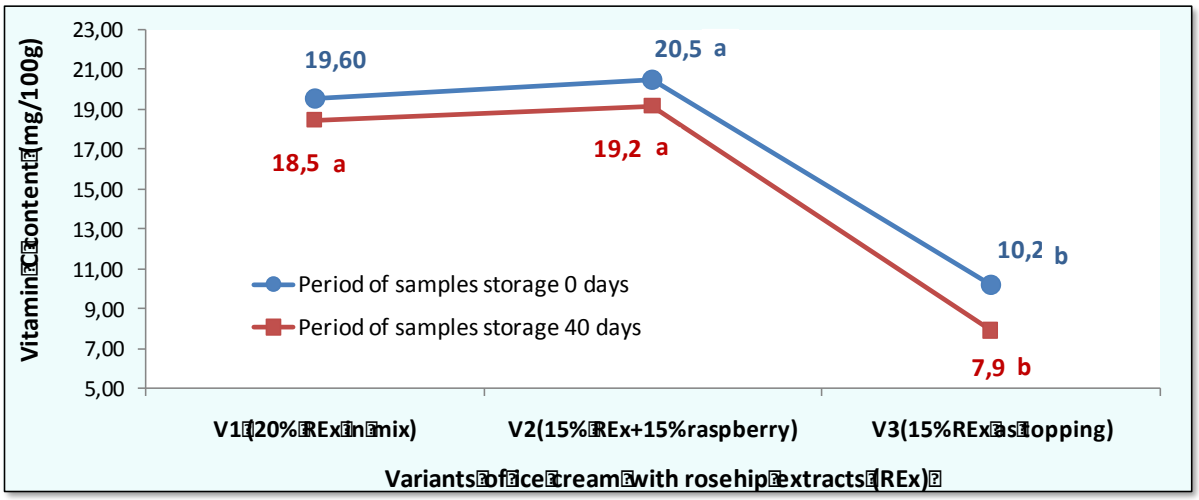

Fig. 2. *Vitamin C content of the ice cream experimental variants obtained using rosehip extracts and almond milk. Data are means of three experiments. Values with different letter differ significantly by Duncan test ($p<0.05$).*

Palich (1994) and Goraya (2018) also reported the deterioration in sensory quality of ice cream with the passage of time.

3.3. Vitamin C of the ice cream variants

As can be seen in figure 2, the highest value of vitamin C content were determined in ice cream samples from variant V2 and V1 (20%, respectively 15% rosehip in mix). Significantly differences were observed between these samples and the ice cream with rosehip extracts used as topping (variant V3). These differences between the variants were maintained after a stage period of 40 days (fig.2).

3.3. Microbiological analysis results

The interpretation of the analyzes was carried out after the incubation of the Petri dishes and their examination. The limits set according to R(EC) 2073/2005 refer to each sample unit tested, in which case the product does not exceed the limit of 100 colony forming units/g during the storage period, the results being satisfactory, as all values observed indicate the absence of the bacterium *Lysteria monocytogenes* (fig. 3).

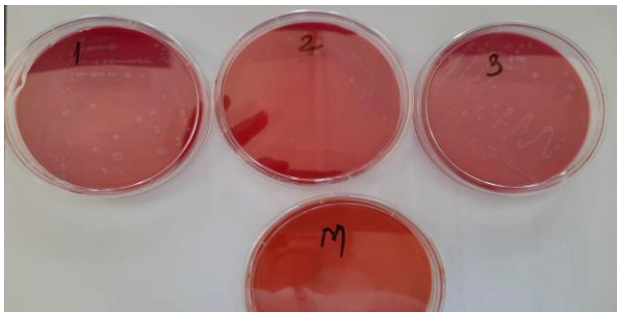

Fig. 3. *Interpretation of the microbiological analysis.*

Taking into account the nutrient intake of the sources used, their accessibility and special properties of the rosehip extracts (valuable "gift of the nature") we hope that the ice cream prepared with this ingredient and without milk products will received a top position in consumer preferences.

Conclusions

Almond milk ice cream with rosehips extracts could be a dessert well appreciated by the consumers affected by lactose intolerance, by vegan consumers or by people who want to diversify their menu or try new foods.

Among the three variants tested, the best values for all the quality parameters were obtained for the almond milk ice cream with 15% rosehips and 15% raspberry fruits. After 40 days storage period, this ice cream kept this position between the other variants obtained in this study.

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REDISCOVERY OF *OPHRYS OMEGAIFERA* SUBSP. *HAYEKII* (H. FLEISCHM. & SOÓ) AND *DACTYLORHIZA MARKUSII* (TINEO) H. BAUMANN & KÜNKELE KREUTZ IN THE REGION OF TIZI OUZOU (GREAT KABYLIA, ALGERIA)

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Abstract: *Botanical surveys were carried out in spring 2022 in the wilaya of Tizi Ouzou, allowing the rediscovery of Ophrys omegaifera subsp. hayekii and Dacylorhiza markusii. Ecological ratings are also provided. This rediscovery will enrich the Algerian orchid flora in general and that of the Tizi Ouzou region in particular.*

Keywords: *Orchidaceae, Ophrys omegaifera subsp. hayekii, Dacylorhiza markusii, Conservation, Great Kabylia, Algeria*

1. Introduction

The *Ophrys omegaifera* subsp *hayekii* or otherwise named: The admirable ophrys of Mr. Von Hayek, described for the first time by Geniez and Melki (1991) [1] in Sicily (Mediterranean island of Italy), a species sometimes attached to the much talked about taxon of Tunisia *Ophrys hayekii* H. Fleischm. & Soó, can be considered as Siculo-Tunisian probably extinct from its only habitat in Tunisia more than 100 years ago, or else strictly endemic to Sicily [2].

In Algeria, this Ophrys was discovered for the first time in small Kabylia (Chemini, Bejaia) by Rebbas & Vela (2008) [2], then other research was carried out for the discovery and rediscovery of other new stations in Algeria during recent years (Rebbas & vela 2013; Kreutz *et al.* 2013-2014; Boukehili *et al.* 2018; Babali *et al*., 2018; Hamel *et al*., 2017-2018; Rebbas & Bounar, 2014; Madoui *et al*., 2017; Martin *et al*., 2020; Rebbas *et al*., 2021; Haddad *et al*., 2021) [3,4,5,6,7,8,9,10,11,12,13,14].

In Tunisia, this beautiful ophrys in its home station is Jebel Bou Kornine [15], It has often been compared to *Ophrys atlantica* Munby, and even admitted as a subspecies: *O. atlantica* subsp. *hayekii* (H. Fleischm. & Soó) Soó. This taxon was discovered in 2008 south of Nefza (north-west Tunisia) [16,17]; thus two other stations discovered by the second author of this article (KR) in 2018 in the Msila region [13].

It appears that this species until now had not been reported in the wilaya of Tizi Ouzou due to the lack of exploration and botanical inventory for this region, with the exception of the publication by Kreutz *et al.* (2013) [4], indicating the presence of this orchid in the Bouira region (at the southern limit of Djurdjura).

Dacylorhiza markusii is rare in Algeria which has a disjunct distribution area across the western Mediterranean: North Africa (Algeria), and southern Italy (Sicily). It is an orchid of open mountain forests, scrub and mountain pastures [18, 19].

According to Vela & Benhouhou (2007) [20], Djurdjurén Kabylia takes on the status of a biodiversity hotspot, in relation to its belonging to the Mediterranean basin considered as one of the richest and most complex regions both in terms of geological and biological as well as cultural [21,22,23]. These so-called hotspots are characterized by their specific richness and their rate of endemism, in which a large number of plants find their refuges, including the Orchids [24, 25, 26].

An orchidological inventory of Great Kabylia is necessary, so in this article we mark a point on the rediscovery of *Ophrys omegaifera* subsp. *hayekii* and *Dacylorhiza markusii* in the wilaya of Tizi Ouzou.

2. Description of the study site

Tizi Ouzou nicknamed "the capital of Djurdjura_" and "Col des Genêts" In the North, the limit of the sea, with three hundred kilometers of coast, In the East, the Soummam valley marks the delimitation of the "Great Kabylia" with the "Little Kabylia", In the South, the Djurdjura draws the border nature of Great Kabylia. Its average altitude is one thousand five hundred meters with peaks like Lalla Khadija (2308 m.) and the Hand of the Jew. To the west, the limit can be determined by the course of the Isser wadi and its tributary, the Djemaa wadi.

The relief of Great Kabylia is made up of three parts, maritime Kabylia to the north, Djurdjura to the south and, between the two, the Agawa massif [27].

In the national park of Djudjura, Tikjda is classified as perhumid with a rainfall quotient value (Q2=166) and that of Tala Guilef (Q2=141) is classified as humid. The stations located on the southern side of Djurdjura, from sea level to 1100 m altitude, with 600-900 mm per year of rain, are classified as a subhumid bioclimate. The records of xericity are recorded by the stations of the valley of the Sahel wadi (Q2 < 50) which are classified in semi-arid and arid bioclimate [28].
The region of Tabouda located in the plains (commune of Illoula oumalou), which is located at a maximum altitude of 601 meters above the Mediterranean Sea, southeast of the wilaya of Tizi Ouzou where the station of *Ophrys omegaifera* subsp. *hayekii* is located.

The first station of *Dacylorhiza markusii* is located at the Col de Chellata, at the eastern limit of the Djurdjura National Park, the second station was observed at the Col de Tirourda and the last station is located south of the Akouker (Fig. 1).

Fig. 1. *Geographical location of the observation area of Ophrys omegaifera subsp hayekii and Dacylorhiza markusii in the wilaya of Tizi Ouzou (Wikimedia, 2022 modified)*

3. Methodology

During our botanical outings in the field within the framework of the realization of a doctoral thesis which relates to the inventory of the orchids of the wilaya of Tizi ouzou, cartography and means of conservation; the field was approached in a random way by the authors of the article, thus the identification of the orchids was carried out from the classic morphological botanical characters [18, 19], then checked and updated based on the work of: De Belair *et al* . (2005); Rebbas & Vela (2008 - 2013); Dobignard & Chatelain (2010); El Mokni *et al.* (2012); Kreutz *et al* . (2013-2014); Martin *et al* . (2015) ; Hamel *et al*. (2017); Boukehili *et al.* (2018); Rebbas & Vela (2018); Martin *et al*. (2020); Rebas *et al.* (2021) [29,2,3,30,31,4,5,17,8,6,32,12,13].

The lack of information on the areas of distribution of orchids in the wilaya of Tizi Ouzou let us opt for a random sampling method that directly targets the places of development of Orchids, as had already been done by De Bélair *et al.* (2005) [29] for the whole of Numidia and Rebbas *et al.* (2021) [13] for the wilaya of Béjaia. To this end, land surveys were carried out throughout the year 2021/2022.

At the level of the prospected station, ecological parameters were studied, namely the abundance of the admirable ophrys (number of individuals listed), the altitude (alt), the exposure (ex). A GPS location of the station was made in order to produce a map.

4. Results and discussion

***Ophrys omegaifera* subsp. *hayekii* (H. Fleischm. & Soó) Kreutz**

Perennial herb (Geophyte with tuber) green and glabrous, morphologically close to *Ophrys dyris* or *algarvensis* but is distinguished by a labellum much less convex (almost flat) and narrower [2], plant 15-30 cm, with flowers in a loose spike of 1- 4 flowers rarely 5, Lateral lobes of the labellum longer and narrower, oblong, rounded at the apex, entire, directed forwards and separated from the median lobe by a deep sinus; median lobe narrowed at base, broadly obcordate, margin not crenate. Lip bearing a prominent fold on the median line 15 to 19 mm long, bordered by a narrow yellowish glabrous margin, has a very discreet groove at the base [18].

The petals are relatively long, reaching 3/4 of the sepals, and wavy. The underside of the labellum is nuanced with reddish-brown and dark green becoming lighter towards the base [2].

Ophrys omegaifera subsp. *hayekii* was observed by one of us (Z. BSS) during a botanical survey of the Tabouda region (Iloula Oumalou commune, Tizi Ouzou) on 04.19.2022. The orchid is characterized by broadly oval lanceolate lateral sepals; large petals; hairless, subspatulate; the center of the petals is yellowish green, a little darker than the sepals, with wavy olive-coloured edges, for the labellum it is horizontal; quite convex, slightly swollen in the basal part of the labellum [33].

The flowers at the bottom of the open flower bud only and other individuals observed in buds (Fig. 2, 3) was the famous and rare Sicilian orchid " *Ophrys mirabilis* " at the start of its flowering!

A second outing was carried out by one of us (Z.BSS) for the station on 22.04.2022 to collect a specimen of *Ophrys omegaifera* subsp. *hayekii* and put it in herbarium.

The last outing (confirmation outing) with the second author (KR), on 07.04.2022 was maintained, allowed us to observe the individuals in full bloom, as well as to inventory other beautiful orchids from the same station and to other station nearby, to take beautiful photographic captures for the rediscovery station.

The population of *Ophrys omegaifera* subsp. *hayekii* is considered globally stable, although abundance and rarity differ from country to country. It is considered abundant in Italy [34] and very rare and localized in Tunisia [17], where only a few individuals are known in the only recorded site. In Algeria, it is estimated that 10 to 20 individuals occur per station [2, 35].

Fig. 2. *Top left: Ophrys omegaifera subsp. hayekii photographed at the start of flowering on 04/19/2022. Top right: measurement of the labellum of Ophrys (Photos Z. Ben si said). Bottom* left: individual of *Ophrys omegaifera* subsp. *hayekii photographed on 07.05.2022, bottom right: general view of the rediscovery station (Photos K. Rebbas)*

Fig. 3. *A specimen of O. Omegaifera subsp. hayekii for the herbarium, Tabouda (Illoula Oumalou), 22.04.2022, photo Z. Ben Si Said*

***Dactylorhiza markusii* (Tineo) H.Baumann & Künkele**

This orchid is quite rare in Kabylia, in the pastures, scrub and mountain forests. Recently the two authors (KR and ZBSS) rediscovered a station of this orchid at the Chellata pass, upstream of the road leading to Illilten on 05/11/2022 (Fig. 4).

On 05/18/2022, more than 100 individuals were observed after the source of the Djurdjura hotel towards Assouel (Kef Edib) (36°28'09.01"N, 4°10'27.02"E, 1868 m).

On 25/05/2022, 10 individuals were rediscovered in front of a cedar forest at the Col de Tirourda, commune of Iferhounene (36°28'25"N, 4°20'45"E, 1734 m). *Dactylorhiza markusii* was first described in Sicily in 1846 and named in honor of Doctor Markus. It is a rare orchid that has a disjunct distribution area across the western Mediterranean: North Africa (Algeria), and southern Italy (Sicily). It grows on neutral to acid substrates in full sun or partial shade and shows a preference for open mountain forest.

Dactylorhiza romana sl (incl. *Dactylorhiza markusii*) was recently assessed for the IUCN Red List of Threatened Species. *Dactylorhiza romana* is categorized as Least Concern [36].

All orchids are included in Appendix B of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

It is therefore important to propose to classify *Dactylorhiza markusii* in the list of non-cultivated and protected plants appearing in the Algerian executive decree [37].

Fig. 4. *Dactylorhiza markusii and the habitat of the species, southern Akouker - Kef Edib, 18.05.2022, photos K. Rebbas*

Conclusions

This inventory made it possible to rediscover Orchid stations which have not been previously reported in the Tizi Ouzou region.

This region is very original in terms of biodiversity. Several stations in the wilaya have not been prospected, hence the need to travel through these areas, explore the different ecosystems that characterize the region of Great

Kabylia (Forests, high altitude lawns, Maquis, edges of springs, fields of olive grove).

The following actions are recommended to protect these two orchids: habitat protection from agricultural use and land improvement; fence vulnerable sites to protect habitat from trampling; control and management of orchid production from tubers; raise awareness ; protection of living individuals by legislation prohibiting picking or digging up the species; ex situ conservation: artificial propagation, reintroduction, seed collections; monitoring and surveillance of existing populations and sites; estimate the size of the population and study its dynamics [36].

Also the continuation of this work will aim at the botanical exploration of other regions bordering on the wilaya of Tizi Ouzou, thus a generalization of this type of work on the orchids of the other sectors of Algeria will be necessary for the taxonomic clarification and nomenclature of this family and to establish geographical distribution maps of these orchids in Algeria.

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WEED FLORA OF CROPS IN THE HAMMAM DALAA REGION (M'SILA, ALGERIA)

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Abstract: *The flora of the cereal fields and of the olive groves of Hammam Dalaa has 116 species belonging to 27 botanical families and 94 genera. Note the presence of native flora which finds refuge at the edge of the fields. Three families, the Asteraceae, the Poaceae and the Brassicaceae respectively dominate. Mediterranean floristics predominate and characterize the wild flora of the fields. Species biological types reveal the dominance of therophytes over all biological types, followed by hemicryptophytes and geophytes.*

Keywords: *weed flora, plants of economic interest, inventory, chorology, M'sila, Algeria.*

1. Introduction

Algeria has an extremely rich and varied flora in the coastal regions, the mountainous massifs, the high plateaus, the steppe and the Saharan Oases. Quezel & Santa (1962-1963) listed 3,139 species including 653 endemic species [1].

Weeds are the spontaneous companions of crops, plants that grow without being sown. The term weed has no pejorative connotation; a weed only becomes a weed when it becomes unwanted, which of course depends on the species considered, its competitive power under local conditions and its density [2].

All species that enter crops are commonly referred to as “weeds” [3]. For the agronomist, a “weed” is a plant introduced spontaneously or involuntarily by man into cultivated biotopes. A weed is any plant that grows where its presence is undesirable. The term "weed" therefore involves a notion of nuisance, and in cultivated areas in particular, any species not deliberately sown is a "weed" which becomes a "weed" beyond a certain density. That is to say as soon as it leads to damage which materializes, in particular, in a drop in yield [4].

In Algeria, there are few works carried out on weeds: Chevassut (1956, 1971), Kiared (1985), Chevassut *et al.* (1988), Boulfekhar (1989), Zermen (1989), Kadid (1989), Fenni (1991, 2003), Abdelkrim (1995), Loubezda (2005), Henni (2005), Benarab (2007), Boudjedjou (2010), Kazi Tani *et al.* (2010), Boudjedjou & Fenni (2011), Rebbas *et al.* (2012), Rebbas (2014), Rebbas *et al.* (2019), Tabbi & Chergui (2019), Melakhessou *et al.* (2020), Zedam *et al.* (2021) and read Vela *et al.* (2021) [5ab, 6, 7, 8, 9, 10, 11ab, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, s25].

The purpose of this work is to inventory the weed flora of cultivated fields in the Hammam Dalaa region, followed by a taxonomic, biological and chorological analysis of this flora from the flora of Quezel & Santa (1962-1963) [1] and the synonymic index of the Flora of North Africa by Dobignard & Chatelain (2010-2013) [26]. Thereafter it will be indicated the economic interest of this flora for the local population of Maadid.

2. Materials and methods

2.1. Geographical location of the study area

The study area is located in the north of the wilaya of M'sila, and is limited to the north by Mansoura, El Achir and to the east by Ksour, El Ach, to the west by Melouza and to the south by Tarmont and Ouled Mansour (Figure 1).

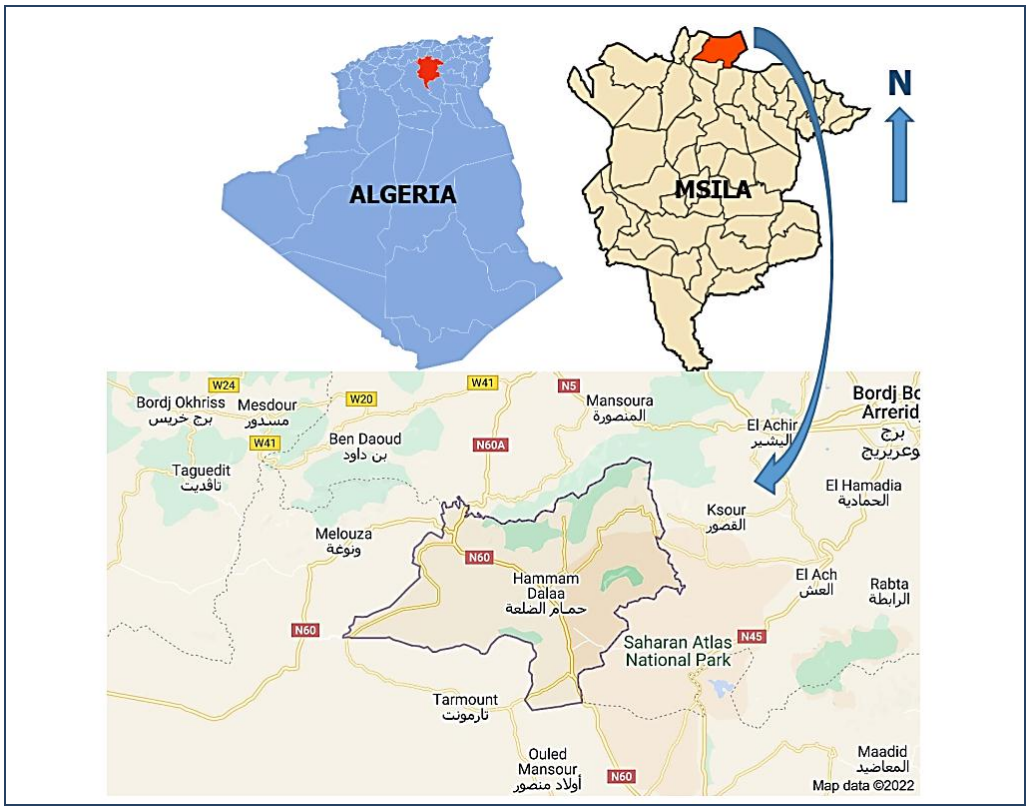

Fig. 1. *Geographical location of Hammam Dalaa*

2.2. Natural conditions

The Hammam Dalaa region has no weather station. The closest posts are those of M'sila and Bordj Bou Arreridj. The average annual rainfall is 221 mm at the M'Sila station, on the other hand they are 385 mm at the Bordj Bou Arreridj station. The mountain ranges receive larger quantities of water, of the order of 400–500 mm in the Saharan Atlas and possibly reaching more than 600 mm in the Hodna and Aurès-Belezma mountains.

2.3. Field trip and sampling

The period of field trips is decisive for any work aimed at inventorying the vegetation and knowing the physiognomic state of the species (flowering, fruiting) which varies during the seasons. Sampling consists of collecting data by choosing elements in such a way as to obtain objective information of measurable precision on the whole of the plant communication studied.

We carried out the subjective sampling which enabled us to carry out two outings of prospecting and floristic inventory of weed plants at the level of 4 fields located in the region of Hammam Dalaa: Two fields of cereals and two other fields of cereals with olive plantation. For the preparation of a herbarium, we collected plant samples during the months of March, April and May 2019 (Fig. 2).

2.4. Determination and nomenclature of taxa

The results of the inventory will be presented in the form of a table (Annex), following a systematic order of higher units, and alphabetically of families, genera and species. We will indicate for each taxon having changed name the corresponding one in the flora of Quezel & Santa (1962-63) [1]. The biological type of each taxon is represented using the following abbreviations: Ph: phanerophyte, Ch: chamaephyte, He: hemicryptophyte, Ge: geophyte, Th: therophyte. According to Miara *et al*. (2017) [27], the different chorological types are represented as follows: Med: Mediterranean, Iber-Maur: Ibero-Mauritanian, End NA: North African endemics, End Alg-Tun: Algerian-Tunisian endemics, End Alg-Mar: Algerian-Moroccan endemics , End Alg: Algerian endemics, Sah: (Saharan, Euras: Eurasian, Eur: European, Paleo-Temp: paleotemperate, Bor: circumboreal, Atl-Med: Atlantic Mediterranean, Eur-Med: Euro-Mediterranean, Med-As: Mediterranean Asians, Med-Sah-Sind: Mediterranean-Saharo-Sindian, Med-Ir-Tour: Iranian-Turanian Mediterranean, Neo-Trop: neo-tropical, Cosm: cosmopolitan.

The biological and chorological types were assessed through the bibliographical documents consulted (Quezel & Santa, 1962-63[1].; Dahmani, 1997 [28]., Rebbas, 2014 [20].), as well as our personal field observations and herbarium specimens for the types biological. We have used the symbol (*) to designate the new chorological data appearing in the index of Dobignard & Chatelain (2010-11-12-13) compared to those of Quezel & Santa (1962-63) [1]. Appreciation of Abundance and Rarity (Quezel & Santa, 1962-1963) [1]: AC, C, CC, CCC: fairly common, common, very common, particularly widespread. AR, R, RR, RRR: fairly rare, rare, very rare, extremely rare. Phytogeographic distribution in Algeria (Quezel & Santa, 1962-1963) [1]:

K1 = Greater Kabylia;
K2 = Little Kabylia;
K3 = Numidia (from Skikda to the Tunisian border);
A1 = Algiers coastal sub-sector;
A2 = Algiers sub-sector of the Tell Atlas;
C1 = Tell Constantine sector;
O1 = Or an sub-sector of the coastal Sahels;
O2 = Oran plains sub-sector; coastal ;
O3 = Oran sub-sector of the Tell Atlas;
H1 = Algerian-Oranian High Plains sub-sector;
H2 = High Plains sub-sector of Constantine;
AS1= Oran Saharan Atlas sub-sector;
AS2= Saharan Atlas sub-sector; Algerian;
AS3= Constantine Saharan Atlas sub-sector (including Aurès).

Fig. 2. *General view of crop fields and olive tree plantations in Hammam Dalaa (Photos: K. Rebbas, 2019)*

3. Results and discussion

3.1. Family and gender analysis

We presented the wild flora of the fields of cereals and olive trees in the Maadid region in annex 1 according to the nomenclature of Dobignard & Chatelain (2010-13) [26]. We counted 116 species belonging to 27 botanical families and 94 genera (Plate 1-2-3, annex 1). At the family level, *the Asteraceae* were the best represented with 26 species (with 3 species of the *Centaurea genus* , followed by the other genus with a number of species less than 2: *Artemisia, Atractylis, Calendula, Carduncellus, Cichorium, Echinops, Galactites, Lactuca, Launaea, Matricaria, Onopordum, Pallenis, Phagnalon, Scolymus, Scorzonera, Silybum, Sonchus, Urospermum*). The *Poaceae family* occupies the second position with 11 dominated species essentially by *Phalaris* with 2 species. The other

genera (*Avena, Bromus, Cynodon, Hordeum, Lolium, Stipa, Triticum*) were represented by 1 species. Then Brassicaceae with 10 species occupy the third position in the inventory. Other families were moderately represented in the inventory such as Liliaceae (9 species), Apiaceae (7 species), Fabaceae (7 species), Papaveraceae (6 species), Lamiaceae (6 species), Ranunculaceae (4 species), Boraginaceae (4 species).

Finally, the other families, very poorly represented, with less than two species each: Amaranthaceae, Cistaceae, Crassulaceae, Fumariaceae, Malvaceae, Resedaceae, Oleaceae, Plantaginaceae, Solanaceae (2 species), then Aizoaceae, Anacardiaceae, Caryophyllaceae, Geraniaceae, Globulariaceae, Iridaceae, Scrophulariaceae, Thymelaeaceae, Zygophyllaceae (1 species).

3.2. The biological types analysis

Plant life forms are a valuable tool for describing the physiognomy and structure of vegetation. Biological type's sensu Raunkiaer (1934) [29]. incorporate various essential aspects of plant life. According to McIntyre *et al* (1995) [30], these biological types, by their definition (position of renovation organs during the bad season), first take into account the physiology and forms of resistance of plants, hence their proven major role in the response of communities to various disturbances (Miara *et al*., 2017) [26].

The analysis of the biological types in annex 1 clearly shows that therophytes represent the major part of the biological types in the inventory, with 64 species. The often-biennial hemicryptophytes, with 23 species, come second. Followed by geophytes with 12 species, phanerophytes with 6 species and chamaephytes (6 species) occupy the third and fourth position in the inventory respectively.

3.3. Chorological types

The analysis of the flora in the table in annex 1 reveals a high number of elements of the Mediterranean group over all the other groups with 46 species. The Mediterranean group was dominated by strictly Mediterranean elements with 46 species followed by the "wide distribution" group occupies the second position with 22 species, gathering 6 cosmopolitan species, 6 Euro-Mediterranean species, 4 circum-Mediterranean species, 3 western-Mediterranean, 3 Iranian-Turanian Mediterranean species. The Nordic group was represented by 8 Eurasian species, 3 paleo-subtropical species, 2 paleo-temperate species and 1 European species. Finally, the group of endemics was represented by 3 North African endemic species.

Conclusions

The non-exhaustive inventory of wild plants in cereal and olive fields in the Hammam Dalaa region was presented in the form of a floristic list containing 116 species belonging to 27 botanical families and 94 genera. These families were essentially dominated by Asteraceae, Poaceae and Brassicaceae. Note the presence of autochthonous flora which finds refuge at the edge of the fields. The analysis of the biological types of the species revealed the dominance of therophytes over all the biological types, followed by hemicryptophytes and geophytes.

The chorological types of the species show that we were indeed in the presence of a typical Mediterranean flora, with the dominance of the elements of the Mediterranean group over all the other groups. The group of endemics was ranked last with 3 taxa.

These plants have an ethical and cultural interest and they have been used for food, pharmacopoeia or ornamentation in gardens. Some have medicinal properties that are still widely used.

At the base of the trophic chains of the agroecosystem, crop weeds constitute an important functional element for animal biodiversity. Many phytophagous insects consume the green matter of weeds while flower insects feed on the pollen and/or nectar of flowers. Some insects would even be more or less specific hosts of certain messicoles.

Finally, many messicoles are bee plants, in particular blueberries [3]. In 1996, following the 1992 Rio Convention, the French Ministry of the Environment and Regional Planning undertook to implement a policy for the conservation and sustainable use of biological biodiversity (article 6) through a Wildlife Action Program [3].

The absence in Algeria of legislative texts taking into account the protection of the flora of cultivated fields like wild plants remains a real handicap to the safeguarding of this so original flora of rural environments. It is important to propose a list of these plants to be protected by Algerian law.

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Annex 1. *List of plants inventoried in the cultivated fields of Hammam Dalaa (M'Sila, Algeria)*

Family	Species	Vernacular and local name	Habitat / Distribution in Algeria	Biological type	Chorological type
Aizoaceae	*Aizoanthemum hispanicum* (L.) HEKHartmann	Aizoon of Spain, Rh'as, Ghassul, Taghassûlt	Arid or clayey pastures / C. throughout Algeria, except in the Algerian-Constantine Tell	Th.	Med-Iran- Tour.
Amaranthaceae	*Beta vulgaris* L.	Beet, Common Chard, "Silk" "Bendjar"	Cultivated beet / Often ± spontaneous in Algeria	Th.	Euras .- Med.
Amaranthaceae	*Atriplex halimus* L.	Sea purslane, Halime orache, L'gtaf, Armasse	Rockeries, clay slopes, salty db / C. spreading areas throughout Algeria. SS, SO, SC: Common in the mountains	Ph.	Cosm.
Anacardiaceae	*Pistacia lentiscus* L.	Lentisk pistachio tree, "Derou", "Tadist"	Forests, scrub, maquis / CC: throughout Algeria	Ph.	Med.
Apiaceae	*Bunium bulbocastanum* L.	Ground nut, Ground chestnut, Talghouda	Fields, harvests / R: here and there throughout Algeria.	Ge.	End. N / A
Apiaceae	*Petroselinum crispum (* Mill.) Fuss.	Parsley, "Maadnous", "Imzı"	Hedges, fields, gardens /Here and there throughout Algeria, Cultivated.	Th.	Eur.
Apiaceae	*Bifora testiculata* (L.) Spreng.	Bifora testicle	Harvests, crops / AC: throughout the Tell.	Th.	Med.
Apiaceae	*Foeniculum vulgare* Mill.	Fennel, "Besbaca", "Chbets"	Fields, hedges, lawns / CC: throughout Algeria.	Th.	Med.
Apiaceae	*Thapsia garganica* L.	"Derias"	Fields, brush / CC: throughout Algeria	Ge.	Med.
Apiaceae	*Scandix pectenveneris* L.	"Mechta el rhoul".	Fields / CC: throughout Algeria	Th.	Eur. Med.
Apiaceae	*Turgenia latifolia* (L.) Hoffm.	Broad-leaved Turgenia	Harvest / C: in the Tell	Th.	Med.
Asteraceae	*Phagnalon saxatile* (L.) Cass.	Phagnalon of the rocks, "Foddia", "Arfedj"	Brush, rocks /CC: everywhere.	Ch.	W. Med.
Asteraceae	*Echinops spinosus* L.	Fouga el djemel, Kashir, Sor.	Lawn, rockery / CC: throughout Algeria.	He.	S. Med. Sah.
Asteraceae	*Cichorium intybus* subsp. *Intybus* M.	Wild chicory, Siress, Handba baria, lsan bagra, Tilfaf	Uncultivated fields , pastures / CC: everywhere.	Th.	Med.
Asteraceae	*Urospermum picroides (L.) Scop. ex F.W.Schmidt*	False picrid urosperm, Zezouga.	Rocks , paths , sterile places / CC: throughout the Tell	Th.	Eur-med.
Asteraceae	*Silybum marianum* (L.) Gaertn. - check	Milk thistle, Chouk el nassara, Chawk bounagar, Chouq boutli , Zaz.	Fields, ditches, waste places, rubble Nitrophil / CCC: throughout the Tell.	He.	cosm.
Asteraceae	*Centaurea calcitrapa* L.	Caltrop , star thistle , Hassak, Bou Neggar.	Pastures, crops, waste places and rubble/CCC everywhere.	He.	Eur-med.
Asteraceae	*Pallenis spinosa* (L.) Cass.	Spiny Pallenis, Nougd , Rebian.	Open forests, pastures, waste places	Th.	Eur-med.

Asteraceae	Sonchus oleraceus L.	Porbeagle sowthistle, Tifelf Wagerrir	Cultures / CCC everywhere .	Th.	cosm.
Asteraceae	*Lactuca seriola* L.	Sacarole, Necalen.	Paths, vineyards, rockeries, scrub / AC: Tell, Hauts plateaux.	Th.	Paleotemp.
Asteraceae	*Centaurea hyalolepis* Boiss.	Hyaline-scaled Knapweed, Dardar	Fields, waste places, pastures, roadsides .	He.	Germany, Saudi Arabia, Belgium, Cyprus, Egypt, France, Spain, Great Britain, Greece, Iran, Israel, Italy, Iraq, Jordan, Lebanon, Morocco, Palestine, Syria, Turkey, Yemen, Algeria
Asteraceae	*Atractylis cancellata* L.	Latticed atractyle, Nedjemma.	Forests, pastures, fields / CCC: all of Algeria.	Th.	Circummed.
Asteraceae	*Scolymus maculatus* L.	Stained Scolyma, Isri	Uncultivated places , especially clay / CC: throughout the Tell.	He.	Circummed.
Asteraceae	*Scolymus grandiflorus* Desf.	Large-flowered moss	Crops, pastures, sands, rubble. CC: in the Tell, AR: in Orania	He.	Eur-med.
Asteraceae	*Scolymus hispanicus* L.	Yellow thorn , Spanish thistle, Garnina	Crops , pastures , sands, rubble / CC: throughout Algeria.	He.	Med.
Asteraceae	*Mantisalca salmantica* (L.) Briq. & Cavill.	Salamanca Centaury	Dry places /CC everywhere: Forest clearings, pastures	He.	Eur-med.
Asteraceae	*Centaurea melitensis* L.	Maltese Cross, Alitime	Fields, arid pastures/ AC: throughout Algeria	He.	Circummed.
Asteraceae	*Glebionis coronaria* (L.) Spach	Garden Chrysanthemum, Edible Chrysanthemum or Crown Chrysanthemum	Fields, at roadsides - AC: throughout Algeria	Th.	Med.
Asteraceae	*Galactites tomentosa* Moench.	Milky Thistle, Cottony Galactite, Akichaou , Chouq el A mir.	Waste places , paths, rockeries / CCC: all the Tell.	He.	Circummed.
Asteraceae	*Onopordum macracanthum* Schousb.	Badourd	Fields, waste places, pastures, forests / CC: throughout the Tell	Hey.	Ibero-Maur.
Asteraceae	*Calendula arvensis* (Vaill.) L.	Field marigold, Djamir, Razehi7na.	Fields, vineyards , waste places .	Th.	Sub-med.
Asteraceae	*Artemisia herba alba* Asso.	Mugwort, Chih , Ifsi , Zezzare.	Polymorphic plant. Clay steppes , rocky pastures /CCC. H , SS , AR: 01-2-3, Cl, SC: in the mountains.	Ch.	Esp., from the Canaries to Egypt, Asia Occ.
Asteraceae	*Catananche lutea* L	Cupidone, Kidan el Acefleur, Zehla	Dry places / CC: throughout Algeria	Th.	Med.
Asteraceae	*Carduncellus helenioides* (Desf.) Hanelt (*Carthamus helenioides* Desf.)	Zitset	Clay places / CC: 01-2, R: Hl-2, Cl	He.	Alg.Mar.
Asteraceae	*Matricaria chamomilla* L.	Chamomile feverfew	Ggardens, uncultivated fields.	Th.	Euras. Macar. Mar.
Asteraceae	*Scorzonera undulata* subsp. *Alexandrina* (Boiss.) M.	Guiz	CC: H, AS, SS	Th.	Sub-med. Bb.
Asteraceae	*Launaea nudicaulis* Hook.f.	Elgouram	fields, and pastures of dry and desert regions / R: A2, CC: H, AS, SS, SC, SO	Th.	Med. Sah.-Sind.
Boraginaceae	*Anchusa italica* Retz. (A. azurea Mill.)	Blue, or Italian bugloss	Fields, harvests/ CC: throughout Algeria	Th.	Eur- Med.

Boraginaceae	*Echium plantagieum* L.	Plantain leaf bugloss, Leçane el Tsour	Pastures, fields/ CC: throughout the Tell	Th.	Med.
Boraginaceae	*Echium asperrimum* Lam.	Very rough bugloss	Fields, crops, hedges / CC: throughout the Tell	He.	Med.
Boraginaceae	*Borago officinalis* L.	Borage, Harcha, Bouchenaf, Bou Kerich	Fields, crops, hedges / CC: throughout the Tell	Th.	W. Med.
Brassicaceae	*Rapistrum rugosum* (L.) All.	Rough rapist	AC: in the Tell. A: South. polymorphic type	Th.	Med.
Brassicaceae	*Carrichtera annua* (L.) DC. (*Vella annua* L.)	Annual carrichter	Brushwood, steppes / AC: throughout Algeria, except in well-watered areas	Th.	Med.
Brassicaceae	*Lepidium sativum* L. subsp. *sativum* _	Garden cress. "Rechad".	Cultivated, sometimes spontaneous / E. Med.	Th.	E.Med.
Brassicaceae	*Raphanus raphanistum* L.	Ravenella.	Cultures / AC: in the Tell. A: elsewhere	He.	Med.
Brassicaceae	*Eruca vesicaria* (L.) Char.	Arugula, "Semna", Hiagan	Fields, pastures / C: throughout Algeria. AR: SS /| Med.	Th.	Med.
Brassicaceae	*Hirschfeldia incana* (L.) Lagr.-Foss	Rocket , " Lebsane".	Fields, rubble /AC: throughout Algeria	Th.	Med.
Brassicaceae	*Sinapis alba* L.	White mustard, White mustard, Kherdel el abiod	Fields, rubble / C: in the Tell.	Th.	Paleo-temp.
Brassicaceae	*Sinapis arvensis* L.	Field mustard, Khardel.	Fields, sands / AC: in the Tell. A: elsewhere	Th.	Paleo-Temp.
Brassicaceae	*Psychine stylosa* Desf.	Psychine	Clay-gypsum soils. AC: in the Tell and on the high plateaus	Th.	End NA
Brassicaceae	*Moricandia arvensis* (L.) DC.	Moricandie, Cabbage , Gdem , Kromb el Djemel, Tammadjei.	polymorphic type	Th.	Med. - Sah. - Sind.
Caryophyllacea e	*Silene tridentata* Desf.	Three-tooth silenus	Rocky pastures / R: K1, Al, AC: O1-2-3, Hl, AS1	Th.	Ibero-Maur
Cistaceae	*Fumana thymifolia* (L.) Spach ex Webb	Fumana with thyme leaves	Open forests, rock gardens, pastures / CC by all Polymorph	He.	Euras. Af. seven .
Cistaceae	*Helianthemum violaceum* (Cav.) Pers. *(Helianthemum pilosum* (L.) Desf.)	Hairy Rockrose, Ergiga, Fegga, Serd, Zefzel	Open forests, brush and dry places	He.	Med.
Crassulceae	*Sedum sediforme* (Jacq.) Pau	Nice Stonecrop	Rocailles / C: throughout Algeria except in the Algerian-Constantinian Tell	Ch.	Med.
Crassulaceae	*Sedum caespitosum* (Cav.) DC.	Grass stonecrop	Pastures, rockeries /AC: in the Tell	He.	Med.
Fabaceae	*Scorpiurus sulcatus* L.	Furrowed Caterpillar, Covered Fruit Scorpiure	Pasture fields /C: throughout the Tell.	Th.	Med.
Fabaceae	*Lathyrus clymenum* L.	Grass pea	Brush, pasture. Polymorphic plant	Th.	Med.
Fabaceae	*Spartium junceum* L.	Spanish Broom, Tertak , Kessaba, Boutertak.	clay hills /AR: in the Tell	Ph.	Med.
Fabaceae	*Medicago sativa* L.	Alfalfa, Fassa, Safsafa, Netel, Sefsa	Fields, brush / CC: throughout Algeria, except in the Tell, coast. Commonly grown plant	Th.	Eur. As. become sub-cosmop
Fabaceae	*Tripodion tetraphyllum* (L.) Fourr (*Anthyllis tetraphylla* L.)	Four-leaved beetle, Oudna	Pastures/ C: in the Tell.	Th.	Med.
Fabaceae	*Vicia faba* L.	Bean; Foul	Cultivated and often more or less subspontaneous	Th.	Med.
Fagaceae	*Quercus ilex* L.	Holm oak, Baloute, Kouriche	C: in the Tell in the mountains, especially sublimestone, R . and dispersed elsewhere	Ph.	Med.
Fumariaceae	*Fumaria agraria* Lag. *	Fumitory	Cultures / C: throughout the Tell.	Th.	Med.
Fumariaceae	*Fumaria parviflora*	Small-flowered	Fields / C: in all Algeria	Th.	Med.

	Lam.	fumitory			
Geraniaceae	*Erodium malacoides* (L.) L'Her.	False Mauve Erodium, Moudjaïh	Fields, crops / CC: throughout Algeria	Th.	Med.
Globulariaceae	*Globularia alypum* L.	Globular, Ain l'arnab Tasalgha, Chebra, Zerga	Rock gardens, scrubland/ CC: throughout Algeria.	Ch.	Med.
Iridaceae	*Gladiolus segetum* Ker.-Gawl.	Gladiolus , Kheta , Sif er r'orab	Fields, cultivated land / C: in the Tell	Ge.	Med.
Lamiaceae	*Marrubium alysson* L.	Marrioua, Timersate	Pastures, especially clayey / CC: everywhere except on the Algerian-Constantine coast	He.	Ibero-Mar.
Lamiaceae	*Marrubium vulgare* L.	White Horehound, Common Horehound, Mchichtro - Tafergana, Marriout	Rubble, hedges / CC: throughout Algeria	He.	Cosm.
Lamiaceae	*Salvia verbenaca* (L.) Briq.	False verbena sage, Zergtoun, Koussa.	Highly variable plant / CC: throughout Algeria	He.	Med. Atl.
Lamiaceae	*Salvia argentea* L.	Silver sage, “Ferrache en neda”	Rocky and arid pastures, C: Hl-2	He.	Med.
Lamiaceae	*Thymus ciliatus* Desf.	Thyme, Djertil	Lawns, brush / CC: throughout Algeria.	Ch.	End. N / A
Lamiaceae	*Teucrium pseudochamaepitys* L.	Germander small pine	Lawns, scrubland/CC especially in the Tell	Ch.	W Med.
Liliaceae	*Allium cyrilli* Ten. *	Cyrillic garlic	Fields, pastures,/ R: Alg.	Ge.	Eur. Alg.
Liliaceae	*Allium nigrum* L.*	Black garlic	Fields, pastures, forests / C: in the Tell	Ge.	Med.
Liliaceae	*Allium cupani* Raf.	Little Allium	Brush, pasture, forest / C: Tell, Hts Pl. Atl. Sah.	Ge.	E. Med.
Liliaceae	*Allium cepa* L.	Onion, Bsel	Cultivated	Ge.	Med.
Iliaceae	*Allium sativum* L.	Garlic, Thum	Cultivated	Ge.	Med.
Liliaceae	*Allium scaberrimum* J. Serres*	Very coarse garlic, Very scabrous garlic	Cereal fields, roadsides in an agricultural context (Rebbas et al. 2019)	Ge.	Endemic to the Mediterranean region
Liliaceae	*Tulipa sylvestris* L.	Tulip, “Bou zouzou”, “Nefed”, “Nouar el Azra”, “El Azoul”	Forests; pastures, crops, rocks (especially in the mountains	Ge.	Eur.-Med.
Liliaceae	*Muscari comosum* (L.) Mill.	Tail-of-leek, Muscari hairy , Kikout, Azoul, Bou Tesel, Beçal ed dib, Boulbous.	Brush, pasture, forest / C: Tell, Hts Pl., Atl. Sah.	Ge.	Med.
Liliaceae	*Muscari neglectum* Guss.	Sloppy grape hyacinth, grape hyacinth	Forests, scrub / AC: in Oranie and Constantinois: var. atlanticum B. and R.	Ge.	Eur. Med.
Malvaceae	*Malva parviflora* L.	Small-flowered mallow	Cultivated fields, rubble / CC: throughout Algeria, SS, SC	Th.	Med.
Malvaceae	*Malva sylvestris* L.	Wild mallow	Rubble, fields, crops / CC: throughout Algeria, SS	He.	Euras.
Oleaceae	*Olea europea* L.	The wild olive tree (Zabbouj, Zitoun l'bari). The cultivated olive tree (Zitoun, Tezamourt, azemour)	CC throughout Algeria. The olive tree is widely cultivated throughout Algeria in its var. sativa DC.	Ph.	Med.
Oleaceae	*Jasminum fruticans* L.	Bou lila, Agourmi	Forests, brush / CC except on the High plateaus	Ph.	Med.
Papaveraceae	*Papaver rhoeas* L.	Poppy, Large poppy, Bellaâmane	Fields/ C: throughout Algeria	Th.	Paleo-temp.
Papaveraceae	*Papaver hybridum* L.	Hybrid poppy	Fields / C: throughout Algeria	Th.	Med.
Papaveraceae	*Papaver dubium* L. subsp. *dubia*	Questionable poppy	Fields / C: throughout Algeria	Th.	Med.
Papaveraceae	*Hypecoum pendulum* L.	Cumin pendant, Djehira, Sag el IVorab	Rocky fields and pastures / C: throughout Algeria	Th.	Med.- Iran-Tour .
Papaveraceae	*Roemeria hybrida* (L.) DC.	Hybrid Roemery, "Djehira"	Cultivated fields, rubble / AC: everywhere	Th.	Med.-Iran-Tour.

Papaveraceae	*Glaucium corniculatum* (L.) H. Rudolph	Horned poppy, "Bougaraoum", Semsema".	Pastures, rubble / C: throughout Algeria, especially towards the south	Th.	Med.
Plantaginaceae	*Plantago albicans* L.	Yalma, Heulma, Nemla	Lawns, arid pastures /CC: throughout Algeria, but rarer in the Tell littoral	He.	Med.
Plantaginaceae	*Plantago afra* L. (*P. psyllium* L)	Asloudj, Merouach	Lawns, pastures, mostly sandy / CC throughout Algeria, AS: SS, R: SC	Th.	Sub.-Med.
Poaceae	*Stipa tenacissima* L.	Halfa, Lgadime, Tizzi, Demmoug	Forest clearings, steppes Abundant on all the high plateaus and the Saharan Atlas; lacking on the coast of Constantine and Algiers, very abundant in Oranie	He.	Iber.-Maur.
Poaceae	*Cynodon dactylon* (L.) Pers.	Quackgrass, Nijil, nagir, Njem	Crops, pastures, wetlands Everywhere in Algeria; Saharan wetlands	Ge.	Thermocosm.
Poaceae	*Phalaris canariensis* L.	Canary grass	Cultivated, Fields	Th.	Med.
Poaceae	*Echinaria capitata* (L.) Desf.	Echinaria to head	Fields	Th.	Med.
Poaceae	*Phalaris minor* Retz.	Phalaris lesser, Charfal canary seed	Fields, pastures / C: throughout Algeria. AR. SS, SC	Th.	Paleo-subtrop
Poaceae	*Triticum turgidum* L.	Durum wheat	Cultivated	Th.	Med. Eur. Asia. Bitter…
Poaceae	*Lolium perenne* L.	Perennial ryegrass, Zaouane, Oallab, Dhelif, Maddoun	Brush, pasture, clearings/C: Tell	Th.	Atl. Sah. Circumbor.
Poaceae	*Avena sativa* L.	The Kortale, Azqûn	Cultivated	Th.	(Europe, W Asia and N Africa)
Poaceae	*Hordeum murimum* subsp. *leporinum* (Link) Asch. and Gr.	Rat barley, Elfar dumpling	Pastures, crops, rubble, clearings / CC: from the coast to the edge of the Sahara sept. Oasis of the latter.	Th.	Circumbor.
Poaceae	*Bromus rubens* L.	Hamraw, Dil el Djerd, Zehaf el begueur	Steppes, scrub, pastures, forests	Th.	Paleo-subtrop.
Ranunculaceae	*Adonis annua* L.	Autumn Adonis, Annual Adonis, Ben naman, Choulletan	Cultivated fields / AC: in the Tell: ssp. autumnalis (L.) Maire and Weiller	Th.	Euras.
Ranunculaceae	*Adonis aestivalis* L.	Summer Adonis, "drop of blood" or "pheasant's eye"	Fields, pastures / AC: in the Tell. R; elsewhere	Th.	Euras.
Ranunculaceae	*Nigella damascenna* L.	Capuchin grass, Damascus nigella. "Nouar el Mequitfa".	Fields, pastures / C: in the Tell	Th.	Med.
Ranunculaceae	*Ceratocephala falcata* (L.) Pers.	False Ceratocephalus	Arid lawns, fields	Th.	Med-Iran-Tour.
Resedaceae	*Reseda luteola* L.	Yellow reseda	Pastures / AC: in the Tell. A: elsewhere	Th.	Euras.
Resedaceae	*Reseda alba* L.	White reseda, "Qaua el Kherouf"	AC: in the Tell as far as the northern Sahara	Th.	Euras.
Scrophulariaceae	*Linaria triphylla* (L.) Miller	Toadflax in threes	Fields, lawns / CC: throughout Algeria	Th.	Med.
Solanaceae	*Solanum nigrum* subsp. *eu-nigrum* Rouy	Black nightshade, Aneb adib, Merhnenou, Messilla	Fields, crops, rock gardens / CC: throughout Algeria, R: SC, CC.	Th.	Cosm.
Solanaceae	*Solanum nigrum* subsp . *villosum* (L.) BalI.	Yellow nightshade, Aneb adib	AR: throughout the Tell	Th.	Cosm.
Thymelaeaceae	*Thymelaea hirsuta* (L.) Endl.	Bristly passerine, Zaytoun ardh, Methnan djbal	Sands, pastures / CC: throughout Algeria and especially on the coast	He.	Med.
Zygophyllaceae	*Peganum harmala* L.	Harmal	Arid pastures , steppes /CC: 01-2-3, HI-2, ASI-2-3, SS. A: SC, in the mountains	Th.	Iran-Tour.-Eur.

CONSUMER PERCEPTIONS OF FUNCTIONAL FOODS FOR TYPE 2 DIABETES IN ROMANIA AND REPUBLIC OF MOLDOVA

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Abstract: *In the frame of the study, the perception by consumers of functional foods for people with type 2 diabetes, the factors of consumer perception of foods, the principles of their choice of functional foods were studied. The 2 online questionnaires were developed to conduct a survey in 2 countries - Republic of Moldova and Romania; the analysis of the obtained data and their comparison with each other was carried out. On the basis of obtained data, the important conclusions were made that contribute to the prevention of the problem of low demand for functional foods for people with type 2 diabetes.*

Keywords: *consumer perceptions, functional food for diabetes, new food development and investigations, survey.*

1. Introduction

In the process of developing and introducing to the market a new functional product, including products for people with type 2 diabetes, it is very important to evaluate the perception of such a product by consumers (Azzurra *et al*., 2009). The success of the product depends on this, or rather, the scale of its distribution, consumer confidence, the measure of consumption and the improvement of the health status of the population (Baker *et al*., 2022). Factors influencing the choice of food products can be divided into three main categories: organoleptic characteristics, individual human factors (stress level, appetite, preferences, etc.), social factors (state policy, prices, etc.) (Guine *et al*., 2020).

The attitude towards functional foods is also influenced by consumers' perception of the technology used for the production, the degree of compliance of the organoleptic properties of the product with consumer expectations, as well as pricing policy (Nakaweesa, 2006). One of the current approaches is to understand why consumers do not choose functional food. This can be achieved by realizing the risks and barriers on the way to healthy eating (Menrad *et al*., 2006). Therefore, understanding the risks of consumers, their concerns related to processing technologies and new scientific approach, should be the main methodology for the dissemination of functional foods (Spence, 2006). This will allow the development of information strategies applicable to the general population that will bring real health benefits to people suffering from certain diseases (Topolska *et al*., 2021).

Buyers' buying behavior is related to their personal preferences, attitudes, desires, intentions and willingness to make a purchase. This is a complex psychological process that always takes place unconsciously. But nevertheless, it has a huge effect on the effectiveness of the choice and the demand for products (Urala *et al*., 2011).

The aim of the work was to analyze the perception of functional foods by consumers, in particular, awareness of this type of product and attitude to the creation and introduction to the market of a new food product for people with type 2 diabetes.

The objectives were to deepen knowledge about the designated topics and research methodologies; conducting a survey; formulation of conclusions based on the obtained data.

2. Materials and methods

2.1. Study design

The design of the study included setting goals and objectives, deepening in the chosen topic, formulating questions, compiling two online questionnaires, searching for respondents in the territory of two countries and sending out questionnaires, collecting information, its thorough analysis, comparing data across countries, and formulating the most important conclusions.

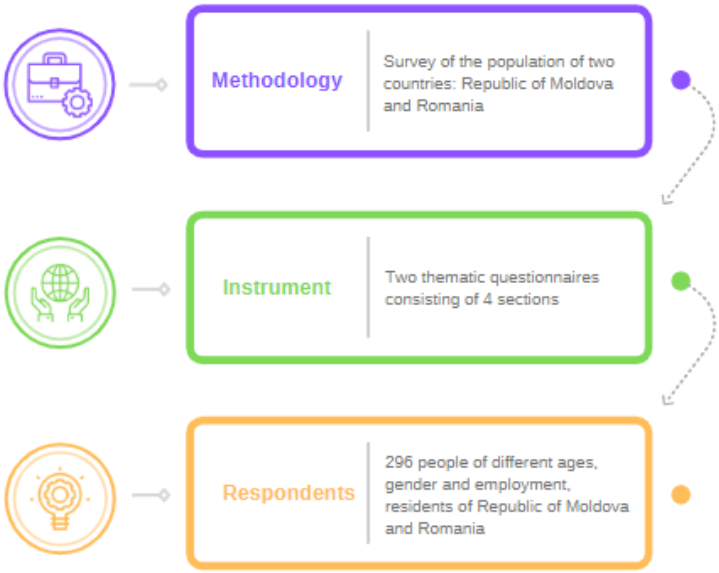


Fig. 1. *Study Design*

2.2. Research Methodology

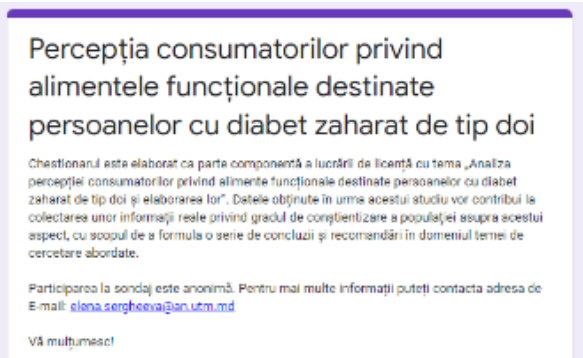
The study of consumer demand for functional foods for people with type 2 diabetes was conducted. For this, 2 online questionnaires were developed. The survey included: determining the consumer profile - socio-demographic characteristics (gender, age, level of education and occupation); determining the awareness of functional foods for people with type 2 diabetes; identification of the main factors influencing the purchase of a functional product; revealing the attitude of consumers and the desire to consume a functional product, as well as the readiness for the appearance on the market of functional foods for people with type 2 diabetes.

A combination of different questions was used to obtain quantitative and qualitative data on sources of information related to functional foods and awareness, perception and understanding of health claims about functional foods. These questions explored current consumption of such foods, current sources of information, need for additional information, motivating factors that might increase consumption of functional foods.

The purpose of some of the questions was also to raise awareness about the definition and properties of functional foods. Hints and explanations were given in the wording of some of the questions, and a separate question presented the correct facts about the characteristics and properties of functional products. Accounting for gender, age, employment and educational level is necessary to compile the socio-demographic profile of the consumer. This data will make it possible to draw the link between the consumer profile and his preferences, awareness and willingness to improve his eating habits.

2.3. Research tool

The working tool of the study was two questionnaires developed in the Google Forms program. Each questionnaire was intended for residents of different countries - the Republic of Moldova and Romania.


Percepția consumatorilor privind alimentele funcționale destinate persoanelor cu diabet zaharat de tip doi

Chestionarul este elaborat ca parte componentă a lucrării de licență cu tema „Analiza percepției consumatorilor privind alimente funcționale destinate persoanelor cu diabet zaharat de tip doi și elaborarea lor". Datele obținute în urma acestui studiu vor contribui la colectarea unor informații reale privind gradul de conștientizare a populației asupra acestui aspect, cu scopul de a formula o serie de concluzii și recomandări în domeniul temei de cercetare abordate.

Participarea la sondaj este anonimă. Pentru mai multe informații puteți contacta adresa de E-mail: elena.sergheeva@an.utm.md

Vă mulțumesc!

Fig. 2. *The fragment of the questionnaire*

The questionnaire was anonymous and did not require filling in personal contact information. For the questionnaires, 25 questions were formulated, which involve obtaining detailed up-to-date information regarding the issues under consideration. Conditionally questions are divided into 4 groups: social nature; questions about functional foods; questions about type 2 diabetes; questions about functional foods for people with type 2 diabetes.

The first group of questions refers to social and consists of four questions. They are designed to reveal general information about the respondents, namely their gender, approximate age, occupation and level of education.

The group of questions about functional foods consists of 8 questions. All of them are designed to reveal the degree of awareness of respondents about the existence of functional products, about their useful properties and functions. Questions of the third group reveal the degree of spread of this disease among the respondents and their environment, which indicates the relevance of the topic, as well as the awareness and attitude of respondents to nutrition in case of type 2 diabetes and its prevention. The fourth group of questions includes questions about functional foods for type 2 diabetes. These questions determine the readiness for the appearance of new functional products, the most preferred category of products.

2.4. Respondents

The respondents are residents of the Republic of Moldova and Romania, men and women of different ages with different employment (students, employees, entrepreneurs, unemployed and pensioners). They were invited to the survey via mailing list, social media announcements and personal invitations. Most of the respondents were women, about 70% of the respondents were students in the first cycle of study. This information is necessary for compiling a consumer profile and analyzing these indicators, comparing them with the level of awareness of respondents, striving for new information and readiness to introduce new food habits into their lives.

3. Results and discussions

179 people from the Republic of Moldova took part in the survey. Most of the respondents are women (64%), half are students. Most of the respondents have insufficient knowledge about functional foods. At the same time, 88% of respondents would like to know more about such products and their effect on the body (fig. 3).

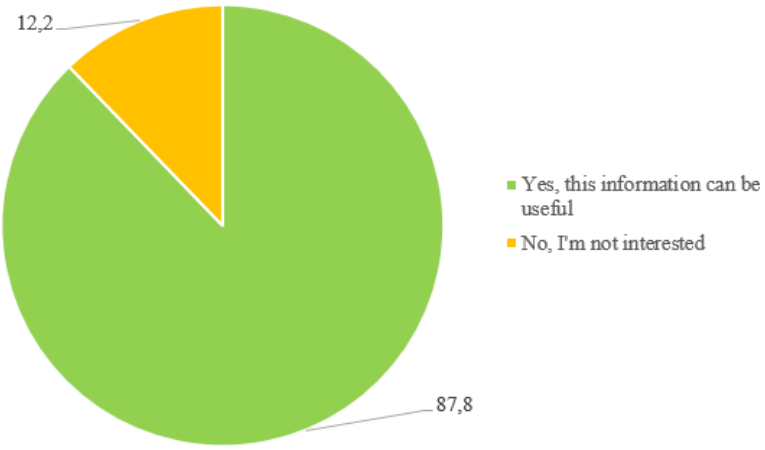


Fig. 3. *Data on the desire of Moldovan respondents to learn more about functional products*

Most respondents (68%) agree that the development and distribution of new functional foods for people with type 2 diabetes can help reduce the incidence (fig. 4). And 94% of respondents believe that it is necessary to expand the range of such products. The most demanded functional foods for people with type 2 diabetes are dairy products and confectionery and sweets.

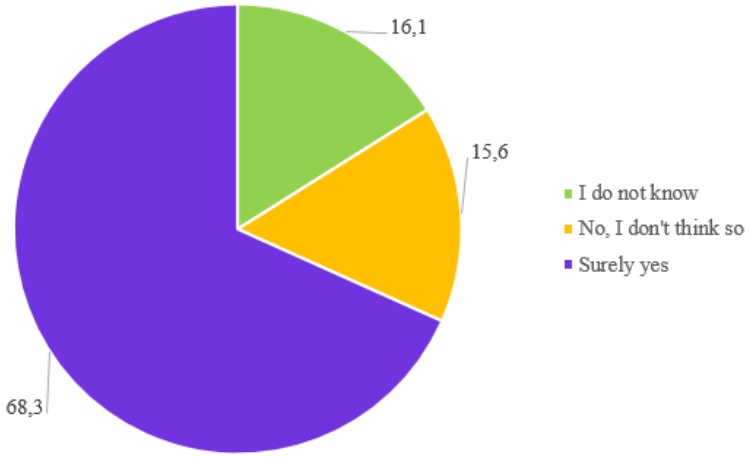


Fig. 4. *Results of the question on the relationship between the development of new functional products and the reduction of morbidity*

When choosing and buying functional products, the most important factors for consumers are the positive effect of products on health, taste characteristics, and the presence of artificial additives (fig. 5). Less important was the price and the way the product was packaged.

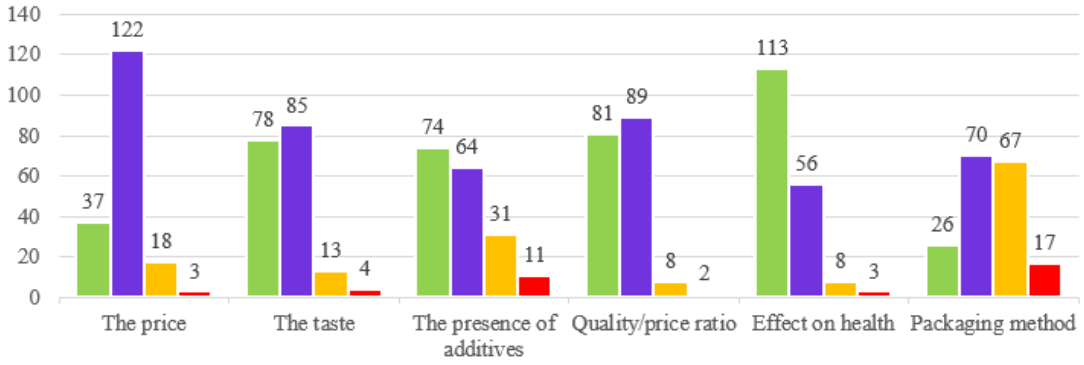


Fig. 5. *Data on the factors influencing the purchase of functional products by Moldovan consumers*

It was also found that the low demand for functional foods is due to the lack of public awareness about the existence, properties and benefits of such products, as well as their high cost and unavailability. Most often, residents of the Republic of Moldova consume functional bakery products and drinks, dairy and meat products. Least often - cereals and pasta, fish and seafood, canned food.

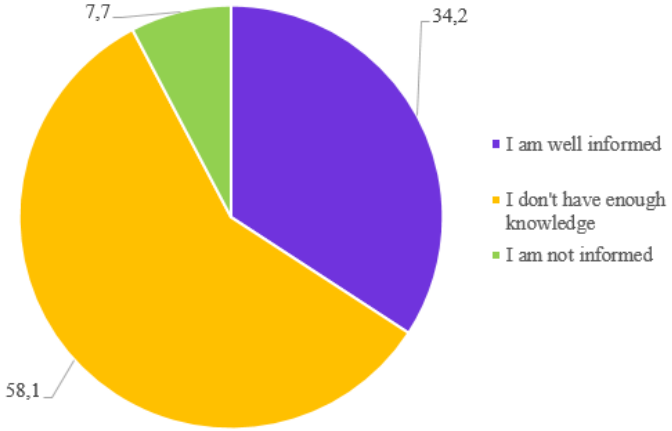


Fig. 6. *Data on knowledge of Romanian respondents about functional products*

The number of respondents from Romania is 117 people. Most of them (58.1%) claim that they have insufficient knowledge about functional foods (fig. 6). However, there were more people wishing to improve their knowledge (98% of respondents). Almost all respondents revealed a desire to learn more about functional foods and include them in their diet, thereby improving their health. The most preferred functional foods for Romanian people are pasta and cereals, as well as dairy products.

94% of respondents believe that lack of awareness is the main reason for the low popularity of functional foods, it is also affected by the high cost, unavailability of such products, poor assortment and the need to abandon food habits. When buying functional products, the most significant factors are the taste characteristics and useful properties of the product, as well as the price/quality ratio, the presence of artificial additives and the price (fig. 7).

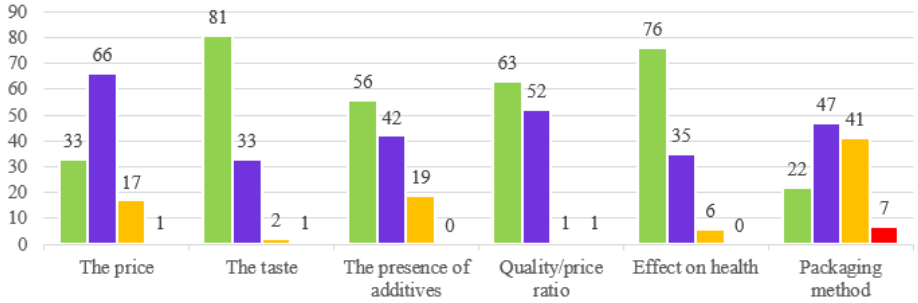


Fig. 7. *Data on the factors influencing the purchase of functional products by Romanian consumers*

More trust among the people of Romania is caused by such sources of information as the Internet and mass media. 77.8% of respondents are confident that the development and distribution of new functional products for people with type 2 diabetes will lead to a decrease in the incidence rate (fig. 8). As a result of a survey of residents of the two countries, common problems were identified: insufficient awareness of the population about functional foods, a small range of such products. Also, the demand for functional food products and the relevance of this topic on the territory of the Republic of Moldova and Romania were identified.

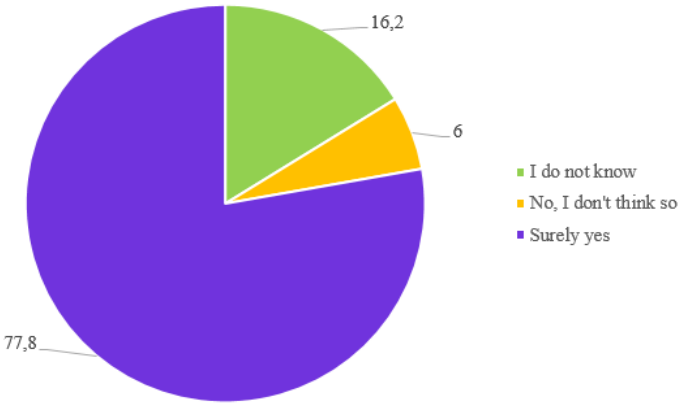


Fig. 8. *Results of the question on the relationship between the development of new functional products and the reduction of morbidity*

Conclusions

As a result of the survey, it was revealed that most of the respondents have insufficient knowledge about functional foods. At the same time, almost everyone expressed a desire to consume such products, but only 18% of respondents from Moldova and 34% of respondents from Romania are aware of their positive impact on health. The most important factor in the purchase of functional foods for respondents was a positive effect on health. The most common reason for refusing to consume functional foods for respondents was the lack of awareness about them, which indicates the need

to disseminate information and introduce it to the masses. Also, there are often problems such as the high cost of such products, their availability and the forced abandonment of eating habits.

88% of respondents from Moldova and 98% from Romania would like to know more about functional foods and their effects on the organism. This fact indicates the insufficiency of advertising campaigns, social videos, etc., that should be corrected in the near future, because type 2 diabetes is a progressive disease, with unfavorable spread statistics, and prevention of these diseases through nutrition is the most effective way to reduce its spread and disease incidence. As a result of the survey, it was found that more than half of the respondents had experienced such a disease as type 2 diabetes, and almost half considered it to be quite common. These data confirm the unfavorable statistics of the spread of morbidity and indicate the relevance of the study.

94% of respondents agree that it is necessary to expand the range of functional products for people with type 2 diabetes. This indicates the readiness of most consumers to introduce such products to the country's market. As a result of the survey, it was revealed that the most popular functional foods for people with type 2 diabetes are dairy products and confectionery and sweets.

As a result of the survey, it was revealed that the market of Romania and Moldova lacks functional foods for type 2 diabetes, and there is interest and demand for such food products among the population, which indicates the need to expand their assortment. The experimental data obtained regarding the perception of functional foods for type 2 diabetes by consumers can make a positive contribution to the coverage of the problem under study and its significance among the population, as well as improve the quality of life of people with type 2 diabetes.

Acknowledgments

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STUDY OF THE FOOD ATTRACTIVENESS OF *LOBOPETRA DECIPIENS* (BLATTELLIDAE) BY *PINUS HALPENSIS (PINACEAE)*

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Abstract: *Insect behavior is not fully defined. Biochemical stimulations of their nervous systems are caused essentially by one or many external factors whether food, sex pheromone, alarm pheromone, gregarious pheromone, and among those insects cockroaches. Many activities in the cockroach populations are based on the use of their antennae like communications and different attractiveness (food, pheromones).*
Our study is focused on applying a series of ethological tests in an olfactometer ("Y "tube) under red light, to test the food attractiveness of one of the forest cockroaches species belonging to the Blattellidae family, which is Loboptera decipiens (L. decipiens); Larvae, males and females. Those tests were determined under laboratory conditions by preparing hexanoic extracts using the fresh and dead leaves of Pinus halpensis (P. halpensis) in three extraction times 15min, 30min, and 60min.
From the obtained results, we were able to indicate that most individuals of L. decipiens have detected the smell of food source, after a detection time that lasts and differs from one stage to another and from one dose of odor to another. These results show that the larval or adult individuals (males and females) are attracted to the hexanoic extracts of fresh leaves of P. halpensis with a percentage ranging from 80% to 100% for females, 73.33% to 86.67% for males and 73.33% to 93.33% for thve larvae. And the dead leaves attract the females from 66.67% to 73.33% and 66.67% of males and 73.33% to 80% for larvae.

Keywords: *Food attractiveness, Forest cockroach, Loboptera decipiens, Pinus halpensis.*

1. Introduction

Insects have been living on earth for about 350 million years, while humans have only been around for about 2 million. They have evolved in many directions during this time to adapt to life in almost any type of habitat and have developed many unusual, picturesque, and even amazing features (Triplehorn & Johnson, 2005). The ability to react quickly to environmental changes makes insects useful indicators of those changes, insects are major engineers and potential regulators of ecosystem conditions, and frequent competitors with human demands for ecosystem resources or vectors of human and animal diseases (Schowalter, 2016).

Cockroaches (Blattodea) have the second-highest number of species of any group of polyneopteran insects (Beccaloni & Eggleton, 2011). Forest cockroaches are the best example of forest litter insects, Often existing in the litter and especially at ground level, these insects feed on plant debris and also help decompose dead leaves (Hedjouli, 2022).

A behavior is a set of acts controlled by the nervous system in response to external factors (Kaiser, 1999). Among cockroaches, a whole range of classical behaviors in insects: food taking, dispersion, escape, and reproduction, but

these last ones also coexist, quite often, with behaviors called presocial. This name covers in fact privileged relationships of the gregarious type between individuals who have a natural tendency to gather. Their communication is largely based on the use of chemical substances called pheromones, which often act at a distance (Brossut, 1996).

In this present work, we tested the food attractiveness by the hexanoic extract of the leaves (fresh and dead) *P. halpensis* in three extraction times (15min, 30min, and 60min) was studied on a poorly known forest cockroach in terms of its biology and behavior, it is *L. decipiens*.

2. Materials and Methods

2.1. Presentation of biological material

Loboptera decipiens:

L. decipiens is a small species 8 to 10 mm with a shiny black body with a yellowish or white stripe on the sides. The legs are often weaker and reddish brown. The elytra are thin and lateral, with a rounded top. The abdomen is somewhat enlarged in the middle. The subgenital plate is transverse in males and in females is often triangular (Chopard, 1943).

Pinus halpensis:

The *Pinus* is an evergreen tree, about 20 to 30 m high, often leaning and not very straight, with a clear, crushed, and irregular top. The leaves are in the form of needles 1mm thick and about 6 to 10 cm long. They are grouped by two, of greyish green color and persistent 2 to 3 years on the tree (Rameau et *al,* 2008).

2.2. Preparation of extract

In a flask containing a volume of 60 ml of hexane, 50g of fresh and/or dead leaves of *P. halpensis* are immersed and left to extract three different times 15 min, 30 min, and 60 min, the extracts are filtered on glass wool in order to eliminate all impurities.

2.3. Food attractiveness test

Based on the plan of (Halfaoui, 2009) and under laboratory conditions we tested the attractiveness of larvae and adults (males and females) of *L. decipiens* by the different hexanoic extracts of fresh and dead leaves of *P. halpensis* in an olfactometer ("Y" tube).

The individual to be tested is placed at the end of the main branch and the filter paper soaked with the plant extract, in one of the secondary branches 5 to 10 minutes before the introduction of the insect. The beginning of the test corresponds to the introduction of the cockroach and for each individual, thanks to a stopwatch, we note the time of detection which corresponds to the moment of the introduction of the cockroach until the moment when it carries out its choice, the choice of the insect and the time it takes to reach the odorant source (the filter paper or the outside).

Fig.1. *Bidirectional olfactometer "Y" shaped tube (Masna, 2016)*
[1-Starting box ; **2-** Olfactometer; **3-** Red lamp; **4-** Compressor; **5-** Flowmeter; **6-** Inlet pipes of air]

2.4. Stastical analysis of data

The results of the ethological tests obtained in an olfactometer are compared using the simulation of Monte-Carlo simulation, based on a Chi-square test with a threshold α=0.05 (Vaillant & Derrij, 1992).

3. Results

3.1.Food attractiveness in L. decipiens larvae via P. halpensis

3.1.1. The attractiveness rate

The larvae of *L. decipiens* were attracted to fresh/ or dead leaves of *P. halpensis* with percentages of 93.33% and 80% in 60min extraction respectively, 73.33% in 15min extraction, and 66.67% in 30min of extraction (Fig. 02).

The results are significant for fresh leaves of *P. halpensis* in 60min of extraction (P= 1.000) (Fig. 02).

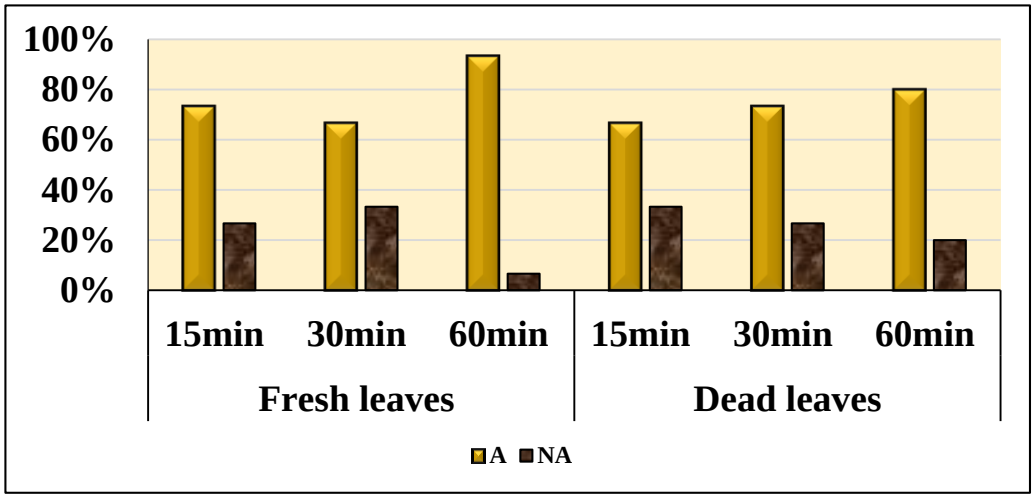

Fig.2. *Food attractiveness rates of L. decipiens larvae (A: Attracted; NA: Not attracted)*

3.1.2. Detection time

Table 1 summarizes the statistical analysis of the different latency times it takes *L. decipiens* larvae to detect the tested odor. *L. decipiens* larvae appear to be attracted to the fresh leaf extract of *P. halpensis* in hexane for 15 min (69.933±11.221).

And they take less time for the 30 min hexane extract of *P. halpensis* (48.067±9.276) and it takes (59.333±7.980) time for the 60 min hexane extract of *P. halpensis*. Statistical analysis of these detection time averages indicates significant differences (F=0.476; P = 0.625) (Tab. 1).

Knowing that for the dead leaves of *P. halpensis* and for the 15min extract, the larvae take (62.800±12.825) and more time (72.533±10.278) for the 30min hexane extract and less time (48.200±7.271) concerning the 60min hexane extract of dead leaves. Statistical analysis of these detection time averages indicates significant differences (F=0.380; P=0.686) (Tab. 1).

Table 1. *Detection time of larvae*

Pinus halpensis					
	15min	**30min**	**60min**	**F**	***P***
Fresh	69.933±11.221	48.067±9.276	59.333±7.980	0.476	0.625
Dead	62.800±12.825	72.533±10.278	48.200±7.271	0.380	0.686
F	0.000	0.037	0.135		
P	0.999	0.848	0.716		

3.1.3. Arrival time

Table 2 presents a summary of the statistical analysis of the different latency times taken by *L. decipiens* larvae to arrive at the tested odor.

L. decipiens larvae appear to be attracted to the fresh leaf extract of *P. halpensis* in hexane for 15 min (173.067±23.132). And they take less time for the 30 min hexane extract of *P. halpensis* (125.000±19.255) and (140.333±20.331) for the 60 min hexane

extract of *P. halpensis.* Statistical analysis of these detection time averages indicates significant differences (F=0.386; P = 0.682) (Tab. 2).

Knowing that for the dead leaves of *P. halpensis* and for the 15min extract, the larvae take (107.333±14.574) and more time (132.733±15.218) for the 30min hexane extract and less time (93.067±9.475) concerning the 60min hexane extract of dead leaves. Statistical analysis of these detection time means indicates significant differences (F=2.303; P = 0.112) (Tab. 2).

Table 2. *Arrival time of larvae*

Pinus halpensis					
	15min	**30min**	**60min**	**F**	***P***
Fresh	173.067±23.132	125.000±19.255	140.333±20.331	0.386	0.682
Dead	107.333±14.574	132.733±15.218	93.067±9.475	2.303	0.112
F	2.397	0.038	9.744		
P	0.133	0.848	0.004*		

(*: Significant)

3.2. Feeding attractiveness in female L. decipiens via P. halpensis

3.2.1. The attractiveness rate

From the results obtained we noticed that the females of *L. decipiens* were attracted 100% to the smell of the extract by the fresh leaves of *P. halpensis* in 60min extraction, 80% in 30min extraction, and 73.33% in 15min extraction (Fig. 3). While the dead leaves of this plant attracted females up to 73.33% in 60 min of extraction, 66.67% in 30 min and 15 min of extraction (Fig. 3).

These results are significant for fresh leaves of *P. halpensis* in 60 and 30 min extraction (P= 1.000; P= 0.978 successively) (Fig. 3).

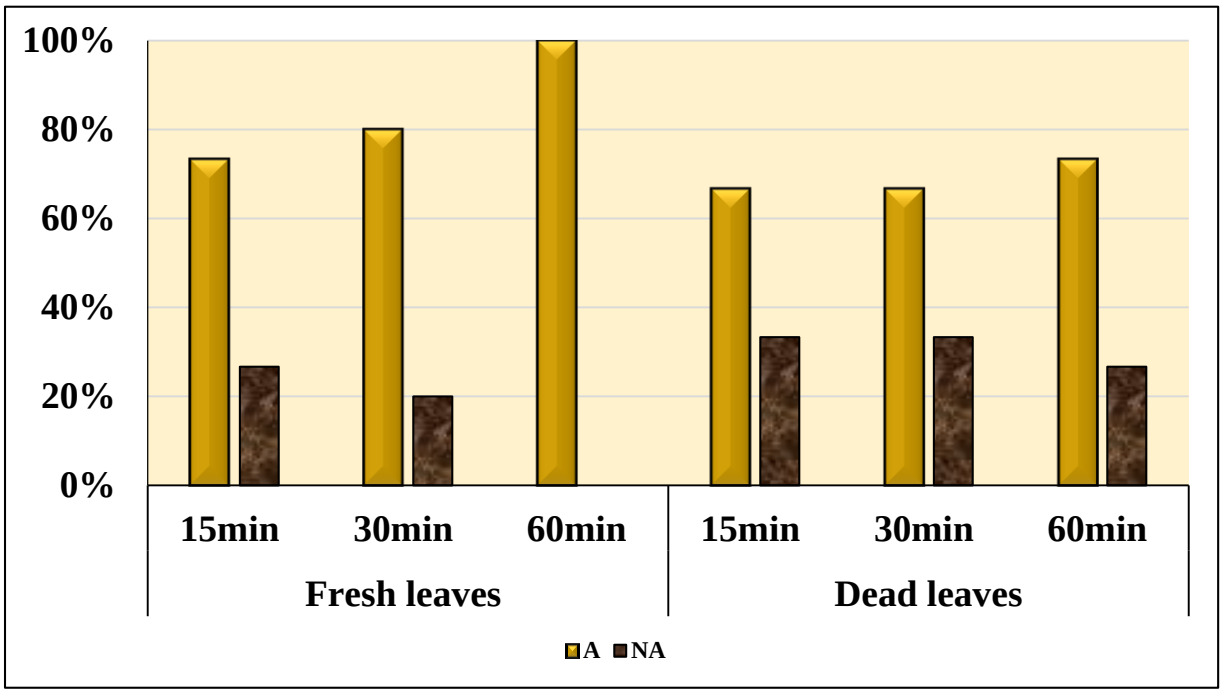

Fig. 3. *Food attractiveness rate of female L. decipiens*

3.2.2. Detection time

Table 3 shows the results of the statistical analysis of the different latency times it takes L. decipiens females to detect the tested odor.

Females of *L. decipiens* seem to be attracted by the extract of fresh leaves of *P. halpensis* in hexane for 15 min (52.667±9.368). And they take less time by the 30 min hexane extract of *P. halpensis* (35.867±7.589) and (41.333±6.606) for the 60 min hexane extract of *P. halpensis.* Statistical analysis of these detection time averages indicates significant differences (F=0.440; P=0.647) (Tab. 3). While for the dead leaves of *P. halpensis* and for the 15min extract,

females take (35.600±9.003) and less time (26.800±4.197) for the 30min hexane extract and more time (47.067±6.888) concerning the 60min hexane extract of dead leaves. Statistical analysis of these detection time averages indicates significant differences (F=1.554; P=0.223) (Tab. 3).

Table 3. *Female detection time*

Pinus halpensis					
	15min	**30min**	**60min**	**F**	***P***
Fresh	52.667±9.368	35.867±7.589	41.333±6.606	0.440	0.647
Dead	35.600±9.003	26.800±4.197	47.067±6.888	1.554	0.223
F	0.118	2.642	0.023		
P	0.734	0.115	0.881		

3.2.3. Arrival time

Table 4 will provide the results of the statistical analysis of the different latency times taken by *L. decipiens* females to arrive at the tested odor. *L. decipiens* females appear to be attracted to the fresh leaf extract of *P. halpensis* in hexane for 15 min (103.267±14.414). And they take more time by the 30 min hexane extract (107.400±24.942) and less time (87.867±11.851) for the 60 min hexane extract. Statistical analysis of these detection time means indicates significant differences (F=2.917; P = 0.065) (Tab. 4).

While for the dead leaves of *P. halpensis* and for the 15min extract, females take (66.133±17.110) and less time (40.800±5.120) for the 30min hexane extract and more time (78.200±14.028) concerning the 60min hexane extract of dead leaves. Statistical analysis of these detection time means indicates significant differences (F=3.346; P = 0.045*) (Tab. 4).

Table 4. *Arrival time of females*

Pinus halpensis					
	15min	**30min**	**60min**	**F**	***P***
Fresh	103.267±14.414	107.400±24.942	87.867±11.851	2.917	0.065
Dead	66.133±17.110	40.800±5.120	78.200±14.028	3.346	0.045*
F	0.005	12.397	0.459		
P	0.945	0.001*	0.504		

(*: Significant)

3.3. Feeding attractiveness in males of L. decipiens via P. halpensis

3.3.1. The attractiveness rate

According to the obtained results we found that the males of *L. decipiens* were attracted up to 86.67% for the odor of the extract by the fresh leaves of *P. halpensis* in 60min extraction, 73.33% in 30min extraction and 66.67% in 15min extraction (Fig. 4).

While the dead leaves of this plant attracted males up to 67.67% in 15 and 60min extraction, and 60% in 30min extraction (Fig. 4). These results are significant for fresh leaves of *P. halpensis* in 60 min of extraction (P= 0.993) (Fig. 4).

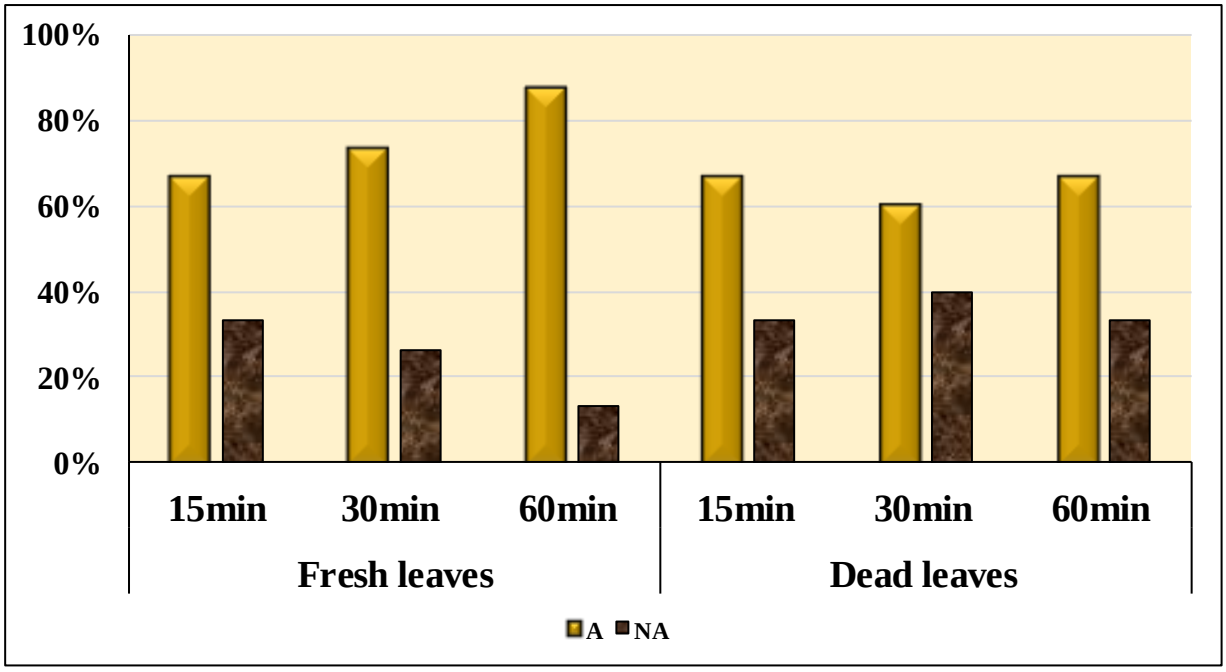

Fig. 4. *Food attractiveness rate of L. decipiens males*

3.3.2. Detection time

Table 5 resumes the statistical analysis of the different latencies taken by *L. decipiens* males to detect the tested odor.

L. decipiens males appear to be attracted to the fresh leaf extract of *P. halpensis* in hexane for 15 min (32.400±4.677). And they take more time by the 30 min hexane extract of *P. halpensis* (35,000±4,714) and (38,933±6,818) for the 60 min hexane extract of *P. halpensis*. Statistical analysis of these detection time averages indicates significant differences (F=1.079; P = 0.349) (Tab. 5).

Knowing that for the dead leaves of *P. halpensis* and for the 15min extract, males take (41.133±7.652) and more time (61.133±9.585) for the 30min hexane extract and (55.333±7.975) concerning the 60min hexane extract of dead leaves. Statistical analysis of these detection time means indicates significant differences (F=0.679; P = 0.512) (Tab. 5).

Table05. Male detection time

Pinus halpensis					
	15min	**30min**	**60min**	**F**	***P***
Fresh	32.400±4.677	35.000±4.714	38.933±6.818	1.079	0.349
Dead	41.133±7.652	61.133±9.585	55.333±7.975	0.679	0.512
F	1.469	6.027	0.412		
P	0.236	0.021*	0.526		

(*: Significant)

3.3.3. Arrival time

Table 6 present the different latencies taken by *L. decipiens* males to arrive at the tested odor. *L. decipiens* males appear to be attracted to the fresh leaf extract of *P. halpensis* in hexane for 15 min (156,600±28,948). And they take less time for the 30 min extract of *P. halpensis* in hexane (130.467±22.339) and (143.733±29.329) for the 60 min extract of *P. halpensis* in hexane. Statistical analysis of these detection time averages indicates significant differences (F=1.544; P = 0.225) (Tab. 6).

Recognizing that for the dead leaves of *P. halpensis* and for the 15min extract, males take (77.933±22.493) and more time (170.867±34.156) for the 30min hexane extract and (114.133±20.449) concerning the 60min hexane extract of dead leaves. Statistical analysis of these detection time averages indicates significant differences (F=1.635; P=0.207) (Tab. 6).

Table 6. Arrival time of males

Pinus halpensis					
	15min	**30min**	**60min**	**F**	***P***
Fresh	156.600±28.948	130.467±22.339	143.733±29.329	1.544	0.225
Dead	77.933±22.493	170.867±34.156	114.133±20.449	1.635	0.207
F	2.454	2.073	2.358		
P	0.128	0.161	0.136		

3. Discussions

Insects communicate with each other in different ways (visual, sound, tactile, chemical, and echolocation). This communication of insects with each other and with their environment is fundamental for movement, feeding, reproduction, and survival. On the other hand, chemical communication or chemical mediator plays a determining role in the biology and behavior of insects (Brossut & Sreng 1985).

In insects, olfactory signals, sometimes much more than visual signals, play a crucial role in the species' life and survival, as well as the relationships between individuals and their environments and between individuals of the same or different species. They are frequently chemical signals that direct the insect to its site of oviposition or food sources (Masson & Brossut, 1981).

Attractive allelochemicals play a major role in whether or not the insect accepts the food (Burden & Norris, 1992). In case of a positive response to an olfactory stimulus, it causes a movement towards the odorant source which can be defined by its speed and direction (Visser, 1986). The effectiveness of an attractant is determined by the initial concentration of the molecule at the source (Ouakid, 2006).

Cockroaches have developed a real chemical communication (Cornnette, 1997), the feeding behavior of cockroaches takes place in a succession of different behavioral sequences leading to the odorant source. In cockroaches, the different behavioral phases of feeding behavior begin with odor detection behavior, after detection the individual (larva or adult) moves towards the odorant source (Halfaoui, 2009). A chemical compound allows the insect to locate its food thanks to an olfactory phenomenon that attracts or repels (Dajoz, 1998).

The main features of the diet are stable within the genus: we are always dealing with omnivores consuming carbohydrates and proteins (Gordon, 1996).

The antennae of *L.decipiens* are an important sensory organ that, in addition to serving as the seat of olfaction, also provides other functions such as gustation, orientation, and touch. It is a mobile organ with many innervated bristles of various forms, the sensilla of tegumentary origin, their intrinsic organization is a function of their role and the mode of development of the insect, and these sensilla are carriers of olfactory neurons, the number of which varies between species (Bouachria, 2005).

The lack of studies on the behavior of cockroaches led us to study the behavior or the food attractiveness of *L. decipiens* with hexanoic extracts of fresh and dead leaves of *P. halpensis*. According to the results obtained we could indicate that females are more attractive than males and larvae where females are 100% attracted to fresh leaves of *P. halpensis* in 60min of extraction where the odor is stronger, moreover, males are attracted to 86.67% to the odorous source of fresh leaves of *P. halpensis* and larvae to 93.33%.

We were also able to mark that the attractiveness towards the odorous source is increased depending on the extraction time where the apolar materials are more extracted depending on the time.

My results are similar to the work of (Halfaoui, 2009) where she found that the individuals of this forest cockroach are better attracted also according to the concentration of the extract; the more the time of extraction of the cork oak acorns increases the faster the attraction of the individuals and the older individuals tested are more attractive than the young larval stages (L1, L2, L3).

The first, second instar larvae of *L. decipiens* are not significantly attracted to the different extracts of cork oak acorns with hexane and pentane while the older larvae seem to be better attracted to these odors.

Conclusion and perspective

The food attractiveness of *L. decipiens* towards *P. halpensis* was studied under laboratory conditions with an olfactometer ("Y"tube), the results allowed us to highlight that this species is always attracted by the different

odors of the hexanoic extracts of fresh leaves much more than the dead ones of *P. halpensis*.

The attractiveness differs from one stage to another and it varies according to the extraction time.

In perspective, it will be interesting to make a thorough study to determine the chemical composition of the studied extract.

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MAINTAINING POTATO QUALITY BY USING THE DIGITAL POTATO AND COMPUTER GRAPHICS FOR ASSESSING RELATION BETWEEN POTATO CONVEYORS VELOCITY AND IMPACT FORCES RESULTED

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Abstract: *The present paper presents a method for analyzing the impact between potatoes transported by belt conveyors at specific velocity 30, 50, 70 m/min and two materials from the potato harvesting chain using a digital potato . The results obtained with this device are important in the harvest and post-harvest potato management for obtaining quality potato for people consumption.*

Keywords: *potato, handling, conveyors, velocity, impact, digital potato*

1. Introduction

Economic losses due to fruits and vegetables bruises are significant. Most of the cost of bruising are passed back on the grower in the form of lower prices, reduced demand and increase storage losses. The effects of bruising are felt by every handler and consumer of potatoes are a major economic drain on the industry [1].

The preponderance of tuber bruising typically results from impacts sustained by the tubers during harvesting and handling. The impacts occur primarily when the tubers strike hard surfaces or each other while being conveyed, or in dropping from one conveyor to another [2].

Severely damaged tubers are an obvious (and direct) cash loss to growers because they are graded out at the packing or processing plant. The cost of impact damage can be enormous. Each defect percentage point is worth $4.2 millions annually to one large international potato processor alone. Impact sensitivity (bruise susceptibility) in fruits and vegetables varies considerably, but a reliable method for assessing, predicting and managing that sensitivity has not been available [3].

Recent advances in measurement of fruits and vegetables tissue impact failure properties, produced new data on the influence of temperature, and strain rate on those properties.

In the conditioning chain, potato tubers are subject to different stress levels both during harvest and during subsequent post-harvest processing. The flow of conditioning involves crossing a path in which they interact with hard impact surfaces, thus being exposed to mechanical shocks. The effect of these interactions consists in mechanical injuries of potato and implicitly in diminution of their quality. This stress cause damage to the produce, compromising its preservability; lowering the consumption quality and bringing considerable economic loss [7].

When the contact between the product and the surface is a low intensity one, such as abrasive rubbing, mechanical injuries can take the form of detachments of portions of the epidermis. This type of injury is specific to roller conveyors, or to the sorting systems of slotted tubers, the products moving by rolling and sliding.

A higher intensity of the interactions between the products and surfaces, generates external forces resulting in the occurrence of the injuries of striking and pressing.

These are the most common types of injuries, are due to static and quasi-static loadings and produce physical changes in texture, color, and appearance.

Harvester evaluations have shown that the most important factor influencing potato bruising is the ratio of ground speed to conveyor speed [8]. If the harvesting takes place with the same machine, it has been found that the percentage of damage can vary depending on the speed of harvesting on the same type of variety.

The experiments carried out in two localities in Bavaria also indicates the influence of the speed of harvesting on the injuries. Orher results shows that the damage is declining at a faster rate. Spech notes that all additional shaking and screening devices must be used with caution as additional damage can occur at low speeds [9] . It was found that without shaking device, at low speeds, the percentage of damaged tubers is around 40%, while when using the shaking device, at the same speed the percentage of injuries increases to 85%. If the speed increases, the differences gradually decrease.

Spech points out that potato varieties react differently to a change in harvest speed. Hunnius and Fuchs show that in order to appreciate the ability to withstand a fully mechanized harvest of a variety, a two-speed harvest is not strictly necessary because the differences between varieties are not so important.

The aim of this study is to anlyse the relation between potato harvesting speed, more preciselly between belt conveyers speed and impact forces resulted, with the positive efects for mentaining potato quality. In this context therefore becomes important, above all, to measure the intensity of the impacts to the produce during harvest and post-harvest and subsequently to correlate this with the probability of damage to the produce itself. For this purpose the researchers in potato mechanical damage fields use impact sensor for assessing mechanical impacts. These sensors are part of a potato shaped element named electronic potato [6].

2. The working frocedure for determining the influence of belt velocity to impact forces

A key element for determining the impact forces is the instrument called electronic potato. The electronic potato is an acceleration measurement device. This device records impact forces received while moving with real potatoes in the harvesting and processing chain. The digital potato quickly locates many damage-causing parts in all types of potato handling machinery (including washers) [6].

Another noteworthy aspect is that the digital potato can focus on very specific levels of damage-causing problems. All information obtained on the stream can be recorded and downloaded to a PC. Thus information about problems in different machines or the same machines at different times can be identified and analyzed; and change its sensitivity to suit different potato varieties or even other fruits and vegetables [6].

The digital potato contains tri-axial shock sensors. In addition to these, the potato has a radio transmitter and a battery. When the potato receives a shock of sufficient strength to register an electronic signal, this signal is transmitted to the 'Receiver'. The signal is heard on the headphones plugged into the receiver, it registers on the receiver's display as it occurs and it is logged into the receiver's memory [6].

The digital potato registers shocks within a specific range. This range encompasses the levels of shock that will bruise potatoes but also includes very low levels of shock which will bruise more sensitive fruit and vegetables. In figure 1 is presented the way of the impact signal.

In order to initialize, the Potato is held in the left hand, against the left-hand side of the receiver so that the yellow spot on the potato is directly against the green shaded start area, and the **Start** button has to be pressed. The digital potato is now ready for operation. The word ready. This can be confirmed by looking at the run timer on the screen.

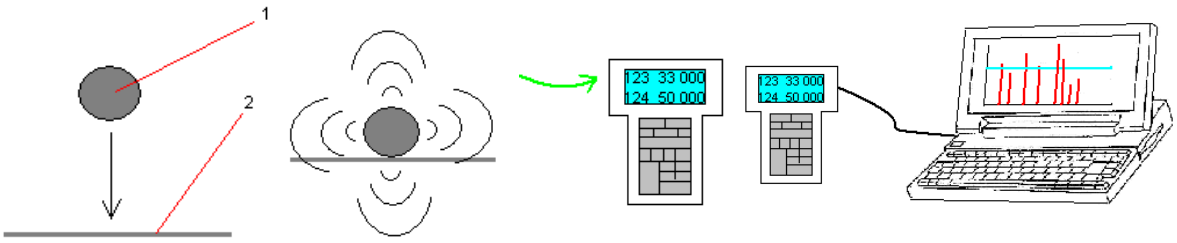

Fig. 1. *The way of the impact signal*
1-The digital potato, 2-The impact surface;

The purpose of this procedure is to determine the influence of the speed of potato tubers transported by means of belt conveyors on the impact that results from their contact with the different surfaces from the handling chain (table . 1). In the end, this influence materializes in

obtaining impact forces. The amount of impact forces , influences the potential of mechanical damage, having consequences on the final quality of the transported tubers. A belt conveyor was used to perform the tests . The conveyor was put at different inclination angles, and the speed of the belt was modified.

In order to determine the impact of the potato in dynamic situations the several steps are necessary. For C profile and sieve band surfaces, the conveyor was first installed at specific angle (15^0) using a hydraulic crane . The impact surface was then put on the front of the conveyor and was lifted by means of a forklift until the distance (H) was in the range of (300...350 mm) (see figure 2).

The speed of the belt was fixed at the specific value (30 m/min, 50 m/min, 70 m/min) adjusting the frequency from the central command panel.

Table 1. *Impact testing surfaces*

Material	Characteristics of the materials		
	Thickness (mm)	Length x width (mm)	Components
C profile band	23	8730x350	Rubber, steel hearth (platband)
Sieve band N 40	18	3560x800	Rubber, steel hearth (platband)

The value of the speed was checked by means of a tachometer . For this part of the experiment two operators were needed. One of the operators adjusts the frequency while the other one is checking the speed of the be belt.

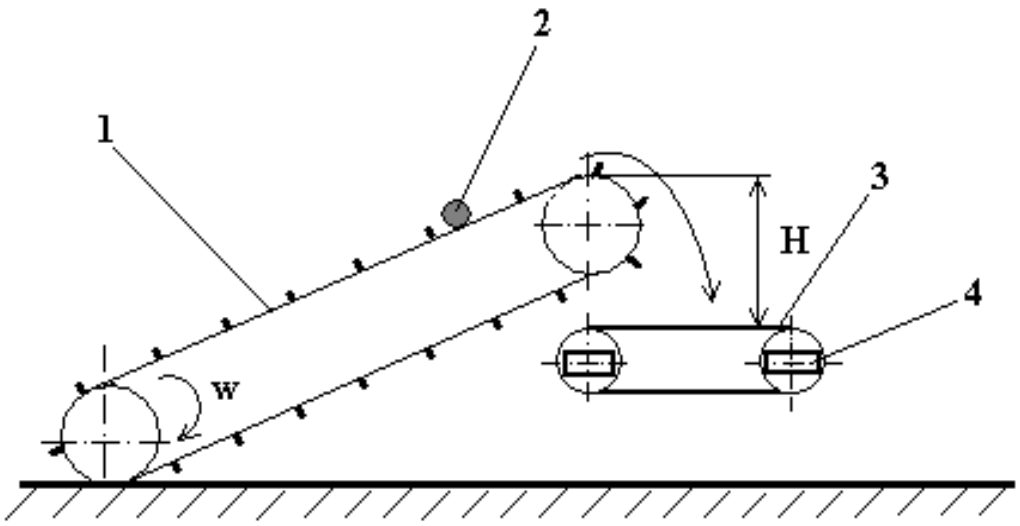

Fig. 2. *The modification of H*
1 – transporting band ; 2 – the digital potato ; 3 – impact surface band ; 4 – lifting machine's arms

The electronic potato was then activated, put on the belt and the moment of impact was marked on the receiver. After 30 recorded impacts a run was completed. In the figure 3 is presented a computer graphical representation for the impact intensity showed by the software provided together with the digital potato.

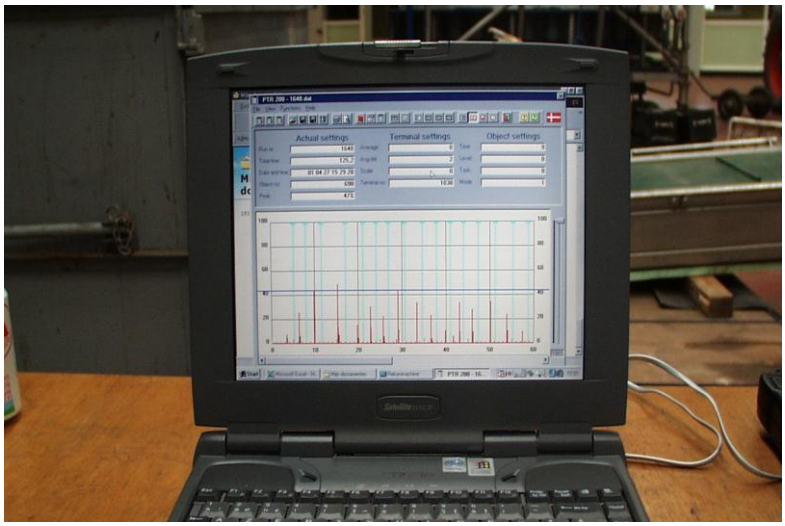

Fig.3. *The impacts shown on the computer screen*

3. Results and data interpretation

In this chapter are presented some results obtained with the electronic potato following laboratory tests. All the data obtained from these tests, were treated and analyzed in order to obtain useful information concerning the impact forces that are exerted on the potato when falling on the different surfaces in different situations from different speeds of conveyors. Following the procedure given by Lishman company and , a lot of useful impact information were obtained using the digital potato. This date were recorded by the receiver. After the data were downloaded from the receiver in the computer, there were exported by the PTR200 program as text files. The next step was to transform these text files into Excel files [6].

When the potato hits the surfaces, the energy of impact was absorbed by a condenser placed inside the potato. Due to constructive defects, the entire energy was not always discharged at once. So there were different delays between several shocks. In the dynamic situation, when the delay between two peaks was less than 0,4 s the shocks were added. When the delay between two peaks was more than 0,4 s the shock were considered to be different . In the static situation, all shocks of the same run were added. This data were used to calculate the impact force value with the next formulas [4].

$$g(x) = 2{,}048 \cdot \ln(x) - 7{,}8877 \qquad (1)$$

where: g(x)=ln(PEAK) , x=F [N]

$$F = e^{\frac{\ln(PEAK)+7{,}8877}{2{,}048}} \qquad (2)$$

Every run resulted in a number of forces. Then, the mean and the standard deviation for these forces were calculated . After that, the t-test was used to statistically analyze the impact forces .The number of calculated forces is different from run to run. This is the reason for choosing the T-test in interpretation of the data.

$$t = \frac{|x_A - x_B|}{\sqrt{\frac{s^2}{n_A} + \frac{s^2}{n_B}}} \qquad (3)$$

, [illegible] ,

where :

n_A-number of forces for the first series, n_B-number of forces for the second series, s_A-standard deviation for the first series, s_B- standard deviation for the second series, t-distribution, s^2-population variances [4].

The T test procedure compares two series of calculated forces. If the t-value is bigger than t□ (provided by the table of t-distribution), the differences between the series considered to be significant. The t-value was calculated with the formulas (2) and (3) .

In the table 2 there are the values for the impact forces acording with three velocities and two surfaces. The inclination angle for the transporter band was 15 degree.

Table 2.

Surfaces	Velocity [m/min]	Force [N]	St. dev.	n[i]
C profile	30	99	33	23
	50	173	109	29
	70	127	41	17
Sieve band	30	214	52	28
	50	232	58	29
	70	249	81	32

From the graph presented in the figure 3 it can be observed for C profiles an increase of the impact force from 99 N to 173 N with the increase of the belt speed from 30 m / min to 50 m / min.

An interesting observation for this type of belt is that when the speed of the belt increases further from 50 m / min to 70 m / min, there is a decrease in the impact force from 173 N to 127 N. For the Sieve band material, a direct proportionality can be observed between the speed of the belt movement and the impact force. Thus, when the belt speed increases from 30 m / min to 50 m / min, the impact force increases from 214 N to 232 N. As the belt speed increases from 50 m / min to 70 m / min, an increase is registered. corresponding to the impact force from 232 N to 249 N. A comparison of the variation curves corresponding to the two types of materials (C profiles and Sieve band) highlights the higher forces on the whole level of the three speeds, recorded for the case of Sieve Band material.

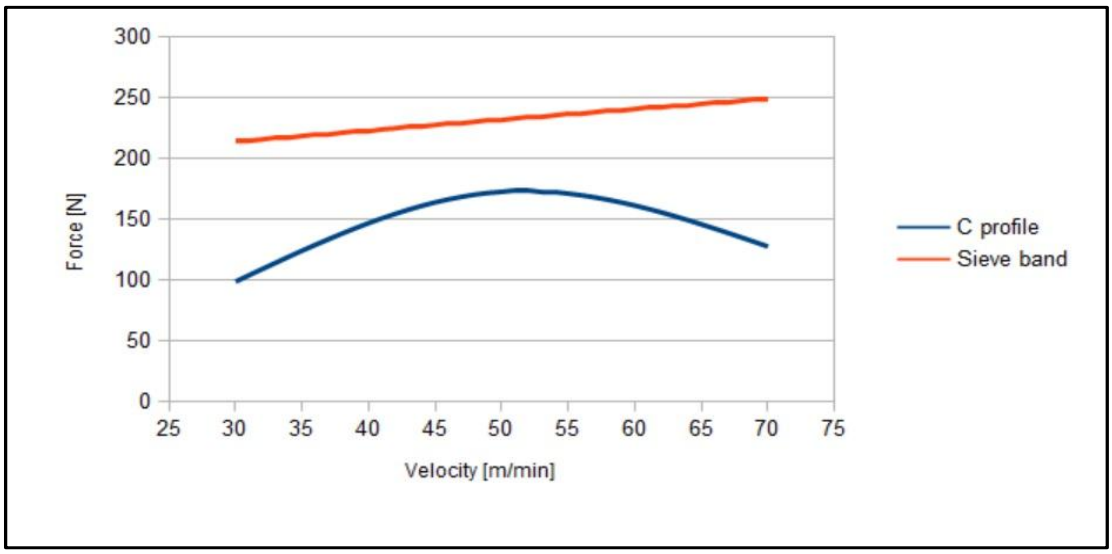

Fig.3. *The velocity force variation*

Conclusions

The digital potato was found to be helpful in discovering information concerning differences between impact forces of a dropped potato in dynamic conditions. The results reveals the differences between impact forces when the digital potato interacts with two impact surfaces and it is positioned on the angle of 15 degrees, for different velocities of conveyor (30m/min,50m/min,70m/min). The advantage of the digital potato is providing the accurate and quick information of the magnitude of the impact for certain situations.

Knowing the relationship between the speed of the conveyors and the resulting impact forces, flow adjustments can be made immediately by decreasing or increasing of the working speeds of the conveyors so that the quality of the tubers can be maintained on the flow of harvesting, transport and storage. The observation found on surface C profiles related to the increase of the speed from 50 to 70 m / minute determines a decrease of an impact force and not an increase of it deserves to be deepened. In general, lowering the working speeds of conveyors is not desirable because the productivity of the process also decreases.

In this context, the increase of the belt speed and implicitly of the productivity of the conveyor to values that would lead to the decrease of the mechanical injuries represents an observation that deserves all the attention for the future research.

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ETHNOPHARMACOLOGICAL STUDY OF MEDICINAL PLANTS USED FOR TRADITIONAL CANCER THERAPY IN M'SILA REGION (NORTHEAST OF ALGERIA)

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Abstract: *Cancer treatment is a major global health challenge in both developed and underdeveloped countries. Hence, finding natural anticancer agents with minimal side effects has become of high priority concern. In response, several plants as a safe therapeutic modality have been used a thousand years ago and remained becoming increasingly popular. This paper aims to provide ethnobotanical surveys of the plants reported anticancer activity used by the local people in M'sila's (Northeast of Algeria-North Africa). The databases revealed that among the 40 plant species reported to be used in the management of cancer 08 of them were the most frequently encountered species, namely Ephedra alata subsp. alenda., Annona muricata L., Berberis vulgaris L., Artemisia herba-alba Asso., Nigella sativa L., Trigonella foenum-graecum L., Ziziphus lotus, Peganum harmala L. The leaves are the most used parts (45.5 %), by infusion or as powder respectively with 43.3 % and 37.5 %.*

Keywords: *Ethnobotany; Anticancer; Medicinal plants; Msila, Algerian traditional medicine.*

1. Introduction

Currently, thousands of chemical substances are used in modern medicine for therapeutic purposes. Every year many new drugs are authorized and brought to market. However, these new drugs are rarely innovative, expensive and cause many side effects due to their lack of specificity and are limited in rural settings [1]. Therefore, there is a need to discover alternative anticancer treatments or prevention against cancer, hopefully more potent, with the cheaper costs as well as more selective and less toxic than those currently in use. Because consumers were provided more information about health, there has been a gradual revival of interest in the use of medicinal plants. Thus, plants are regaining shape and emerging as an integral field of traditional medicines all over the world for the management of diseases. Their tendency has shifted because herbal medicine has been reported safely and less or without any adverse effect especially when compared with synthetic drugs [2]. The use of medicinal plants for diseases management purposes has been in practice since thousands of years and is known in Algeria as Algerian traditional medicine "Alternative Medicine" or "Herbal Medicine" and researchers have worked a lot in this field [3-7].

In Algeria, the use of medicinal plants is a tradition of a thousand years. The population has a long history of herbal use for the treatment of diseases, this knowledge was collected and transferred from generation to generation. The first works on medicinal plants were made in the 9th centuries by Ishà-Ben-Amran and Abdallah-Ben-Lounès, but the largest production of books was carried out in the 17th and 18th century [7], even during French colonialism from 1830 to 1962. Botanists have managed to catalog a large number of medicinal species. In 1942, Fourment and Roque published a book of 200 plant species of medicinal interest, most of them are from the

North of Algeria and only 6 species were located in the Sahara [7]. The most recent work published on Algerian medicinal plants was postponed in the works of Beloued [4] and Baba Aissa [5]. Algeria It has about 600 species of medicinal and aromatic plants [6].

Considering the rich flora of this province, the current study was aims to valorize the flora of local therapeutic interest used in traditional medicine from ethnopharmacological surveys carried out in the M'sila's steppe, exactly in the municipalities of M'sila, Bousada, Magra and Hamam Dalaa.

Produce a catalog of these plants in the region and collect as much information as possible on the therapeutic uses practiced by the local population for cancer treatment. Indeed, it is very important to translate this traditional knowledge into scientific knowledge in order to reevaluate it, preserve it and use them in a rational way.

2. Materials and methods

2.1. Study area

Our survey was conducted on four municipalities of the M'sila steppe namely: Msila, Boussaâda, Magra and Hamam dalaa (Fig. 1). M'sila is one of the central provinces of North-Algeria, it is located between the two mountain ranges the Tellian and Saharan Atlas, it covers an area of 18,175 km2. The M'sila's province is bounded to the West by Djelfa province, to the South Biskra province, to the East with Batna province and surrounded to the North-east with Bordj Bou-Arreridj and Setif provinces and to the the North-west with Médea and Bouira provinces.

Prior to the ancient period, this area was called Hodna. These are the most deprived shreds of the mothers' provinces (Setif, Batna, and Media) which have been grouped together to form in 1974 the province of M'sila. Originally composed of 47 municipalities, grouped into 15 dairates. M'sila province, known as the dust land and the rising sun land, is located in center North-Algeria. The Geographical location of the province is as follows (Fig. 2).

- A mountain area on either side of Chott El Hodna.
- A central zone consisting essentially of plains and high plains.
- A zone of chotts and depression with the Chott El Hodna in the Center East and the Zahrez Chergui in the Midwest.
- An area of wind-blown sand dunes.

The climate is of the continental type, subject in part to Saharan influences, which is warm and frost-free. The big North part of the province receives more than 480 mm per year (Djebel Ech Chouk - Chott de Ouenougha); as to the other dried parts of the territory, located in the extreme south receives less than 200 mm/year. The average annual precipitation of the province in 2018 is 119.0 mm per year. The average monthly temperature of the city is about 32.60 C° recorded in August and 7.30 C° in January.

2.2. Data collection and Analysis

Ethnobotanical survey of M'sila was carried out from March to May 2021. Herbalists, herb sellers and population which has deep knowledge of the herbs, the inhabitants and among them sick-people living within the studied area were interviewed by the administration of questionnaires. The informants were between the 21 to over than 60 years old.

Over 189 questionnaires, with a random sample of the population (users), containing relevant information regarding the plant species, their local names, the proposed treatment (as plant or a mixture of several plants) were also collected to enhance permanent records from the steppe of M'sila.

The questionnaires were collected with prior consent from all the informants respecting the ethical code of the international society of ethnobiology. Ethnobiological plant specimens indicated in this paper were collected, and identified in accordance with taxonomic practice, and thereafter confirmed from the Algerian flora.

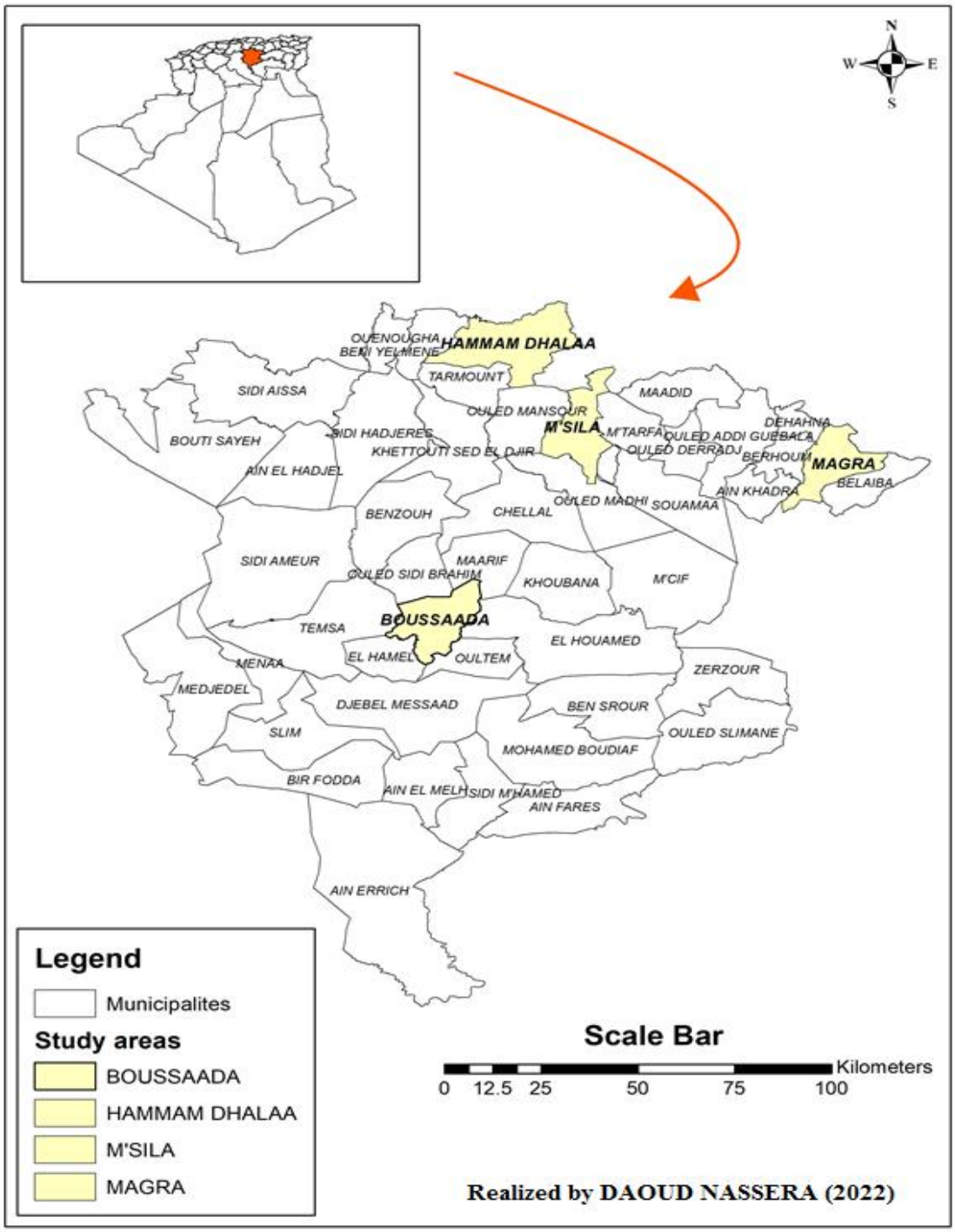

Fig.1. *Localisation and administrative organization of the studied area*

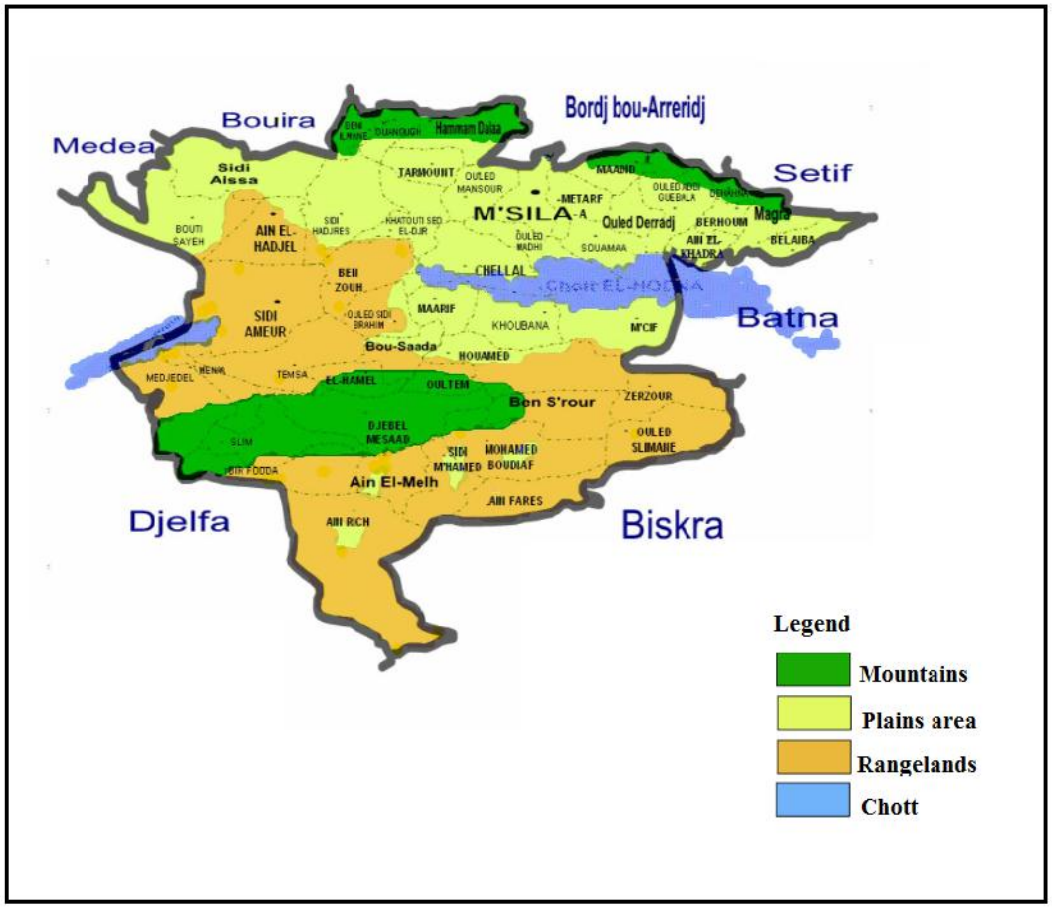

Fig. 2. *Geomorphology (D.S.A. M'sila, 2014)*

3. Results and Discussion

3.1. Medicinal plants biodiversity

On the basis of 189 questionnaire sheet carried out in the study region, an ethno-floristic catalog has been drawn up (Table 1).

This catalog shows the list of the plant species with their botanical names, local names, the used plant parts as well as their application methods. A total of 39 species was encountered to possess anti-cancer properties. Among the identified species, eight of them were the mostly used for the cancer treatment in the region of M'Sila, namely *Ephedra* alata subsp. alenda, *Annona muricata*, *Berberis vulgaris*, *Artemisia herba-alba*, *Nigella sativa*, *Trigonella foenum*, *Ziziphus spina-chisti*, *Peganum harmala L.* (Fig.2).

In terms of biodiversity, the 39 medicinal species countered in this study were one of the lower reported species numbers than the countered species in other research studies from the same country as the reports organized in the table below (Table 2).

Other studies have focused on larger regions out of the country and reported a much higher number of used species (Table 3).

Table 1. *Ethno-floristic catalog of the most used plants for the treatment of cancer in Msila*

	Plant spieces	**Arabic names**	**French names**	**Use part**	**The using mode**
1.	*Aesculus hippocastanum* L.	القسطل الهندي	Marronnier d'inde	Bark/ Leaf	Powder
2.	*Allium cepa* L.	البصل الاحمر	Oignon rouge	Bulb	Raw form
3.	*Allium sativum* L.	الثوم الاحمر/الثوم	Ail/Ail rouge	Seed/Bulb	Raw form
4.	*Aloes vera* (L.) Burm.f. (L.) Burm.f.	مور وصبر	Aloés	Leaf	Gel
5.	*Annona muricata* L.	الجغرافيولا	Graviola	Fruit- fruit's flesh seed	Raw form
6.	*Aristolochia longa* L.	برتسم	Aristoloche	Leaf	Powder
7.	*Artemisia herba-alba* Asso.	الشيح	Armoise blanche	Leaf/Flowering tops	Infusion/decoction
8.	*Atriplex halimus* L.	القطف المالح	Arroche halime	Flowering tops	Powder/infusion
9.	*Cinnamomum* verum J. Pres.	الليمون	Citron	Fruit/Bark	Juice/ Infusion of lemon peel/Decoction
10.	*Berberis vulgaris* L.	عود غريس	Épine-vinette	Bark	Powder with honey/decoction
11.	*Bumium bulbocastanum* L.	ترغودة	chataigne de terre	Root	Powder
12.	*Camellia sinensis* **(**L.) Kuntze	الشاي الاخضر	Thé vert	Leaf	Infusion
13.	*Centaurea erythraea* Rafn.	مرارة الحنش	Petite-centaurée rouge	Flowering tops s	Powder
14.	*Citrus limon* **(**L.) Burm. f.	ليمون	Citron	Fruit	Juce/ Infusion of the lemon peel
15.	*Crocus sativus* L.	الزعفران	Safran	Flower	Powder
16.	*Cuminum cyminum* L.	الكمون	Cumin	Seed	Powder
17.	*Curcuma longa* L.	كركم	Curcuma	Rhizom	Powder/decoction/condiment
18.	*Ephedra* alata subsp. alenda	العلندة	Ephédra	Leaf	juce/ Infusion of the lemon peel / decoction
19.	*Ficus carica* L.	كرموس	Figuier	Fruit	Infusion
20.	*Foeniculum vulgare* Mill.	بسباس	Fenouil	Seed	Infusion/decoction
21.	*Glycyrrhiza glabra* L.	عرق السوس	Réglisse	Rhizome/ root	powder
22.	*Cynara cardunculus v. scolymus* L. Benth.	جذور الخرشف	Artichaut	Leaf	Powder
23.	*Lawsonia inermis* L.	حنة	Henné	Leaf	Powder
24.	*Matricaria chamomilla* L.	بابونج	Camomille sauvage	Leaf	Infusion
25.	*Mentha pulegium* L.	فليو	Menthe pouliot	Leaf	Infusion
26.	*Mentha spicata* L.	النعناع	Menthe verte	Leaf	Powder
27.	*Nigella sativa* L.	الحبة السوداء	Nigelle	Seed	Powder/decoction
28.	*Origanum vulgare* L.	الزعتر	Origan	Flowering tops / leaf	Infusion/powder
29.	*Panax ginseng* C.A. Mey.	الجينسينغ	Ginseng	Root	Infusion/decoction/ powder
30.	*Peganum harmala* L.	الحرمل	Rue sauvage	Leaf	Infusion
31.	*Rosmarinus officinalis* L.	اكليل الجبل	Rosmarin	Leaf	Infusion/raw
32.	*Rubus fruticosus* Linnaeus	توت العليق	Ronce des bois	Fruit	juce
33.	*Ruta chalepennsis* L.	الفيجل	Rude de Chalep	Bark/ Leaf	Infusion
34.	*Silybum marianum*(L.) Gaertn	شوك الجمل	Le Chardon-Marie	Fruit	Powder
35.	*Syzygium aromaticum*(L.) Merr. & L.M.Perry	القرنفل	Clou de girofle	Flower	Powder
36.	*Trigonella foenum-graecum* L.	الحلبة	Fenugrec	Seed	Infuion/powder
37.	*Urtica dioica* L.	الحريق	Grande ortie	Laef	Infusion/decoction
38.	*Zingiber officinale* Roscoe	الزنجبيل	Gingembre	Bark	decoction /powder
39.	*Ziziphus lotus (L.) Lam.*	*السدر*	*Jujube*	*Leaf, flower,fruit*	*Raw, infusion*

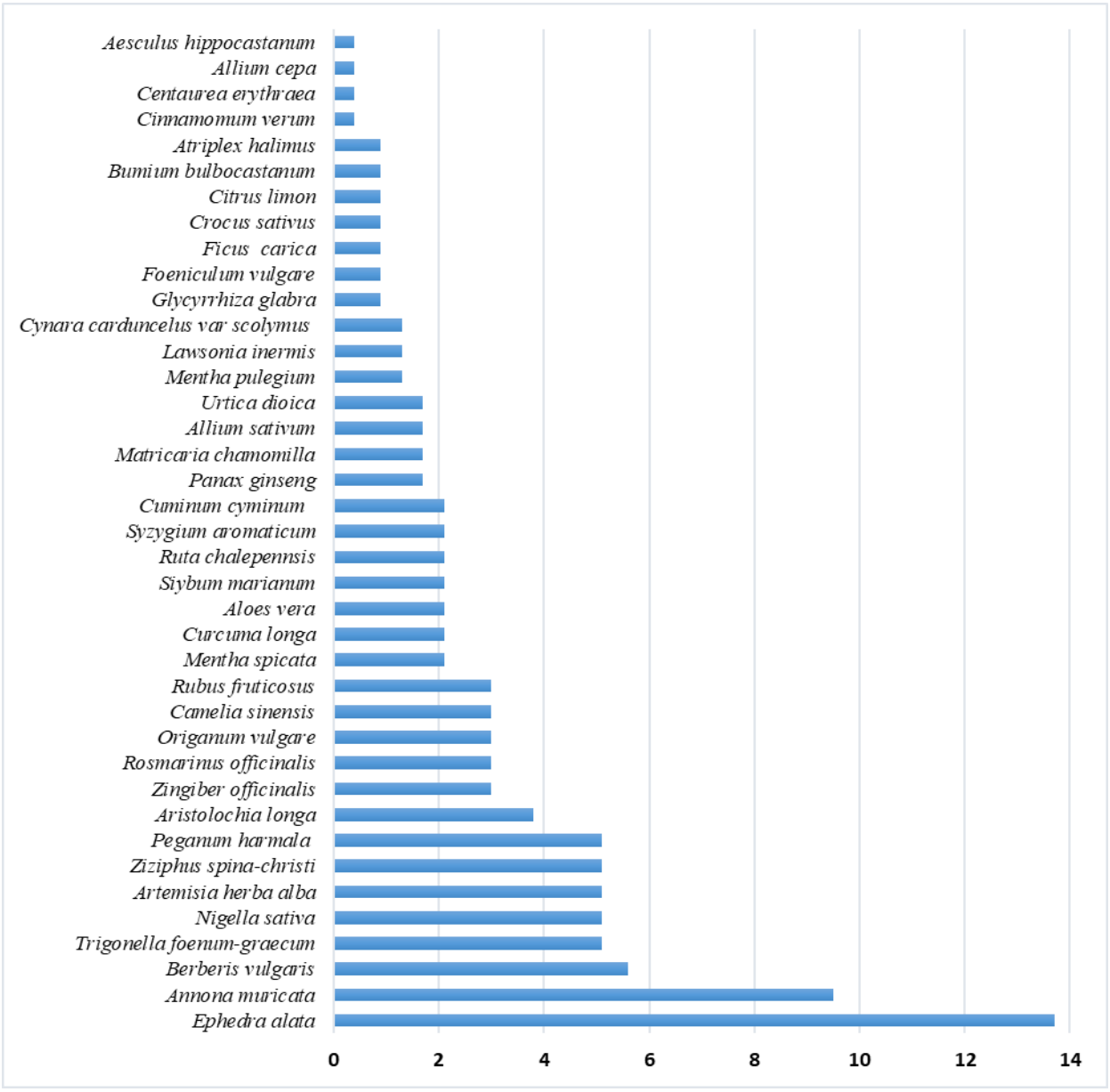

Fig.2. *Frequencies of listed species use against cancer*

Table 2. *Comparison of the plant diversity inside the country*

Studied area	**Species no.**	**Reference**
M'sila	39 species	Present study
M'sila	60 species	Rebbas et al. [8]
Messaâd (Djelfa)	59 spieces	Daoud et al [9]
Tiaret (west Algeria)	66 species	Miara et al. [10]
Oued Right (Algerian Sahara)	53 species	Lakhdari et al. [11]
Kabylia (North-Algeria)	98 specie	Meddour and Meddour-Sahar [12]
El Kala (Extreme East –Algeria)	40 species	Boughrara and Belgacem [13]
Skikda (North- East Algeria)	90 species	Bouasla and Bouasla [14]
Constantine (North- East Algeria)	102 species	Ouelbani et al. [15]
Northwest of Algeria (Tiaret and Tlemcen)	53 species	Bouhaous et al. [16]
Northeast of Algeria (Russikada)	73 species	Souilah et al.[17]
Bordj Bou Arreridj (El Hammadia), Northeast Algeria	78 species	Bendif et al.[18]
Ben Srour (M'sila) Northeast of Algeria	84 species	Bendif et al. [19]
Tuareg communities (Illizi)Algerian Sahara	118 species	Miara et al.[20]
Bordj Bou Arreridj Northeast of Algeria	83 species	Miara et al.[21]
El Harrouch, Azzaba (Skikda) Northeast of Algeria	22 species	Souilah et al.[22]

Table 03. *Comparison of the plant diversity outside the country*

Studied area	Species number	Reference
Spain	335 species	Fakchich and Elachouri. [23]; Eddouks et al. [24]
Spain	224 species	Parada et al. [25]; Benitez et al.[26]
Turkey	222 species	Guzel et al. [27]
Palestine	198 species	Ali-Shtayeh et al.[28]
Ogun - Nigeria	73 species	Mike O. Soladoye et al. [29]

3.2. Plant parts used

Several parts encountered by these ethnobotanical surveys in the study area, have been subjected to evaluate the percentage of use for their potential anti-cancer effects (leaves, stem (rhizomes, tubers, bulbs), roots, seeds, flowers, bulb, fruits, bark).

According to the results, it was observed that the leaves are the most used parts by M'sila people (45.5 %), followed by the fruits with a percentage of 14.7 % and 14.3 % for the seeds, then the barks (10.7 %), the flowers (8.9 %), the stem (4 %) and finally the roots (1.8 %) (Fig. 03).

Comparing to the published literature, this has also been observed by several authors in different regions of Algeria Chermat et Gharzouli, [30]; Ouelbani et al. [15]; Bouasla et Bouasla, [14], and in other Mediterranean countries (Parada et al. [25]; Benitez et al. [26]; Carrió et Vallès. [31]; Tahira et al. [32] ; Tuttolomondo et al. [33]; Guzel et al. [27]; Eddouks et al. [24]. Which may be related to the nature of the active components and the ease of preparation and administration of derived remedies (Bruneton 1 and 2. [34,35].

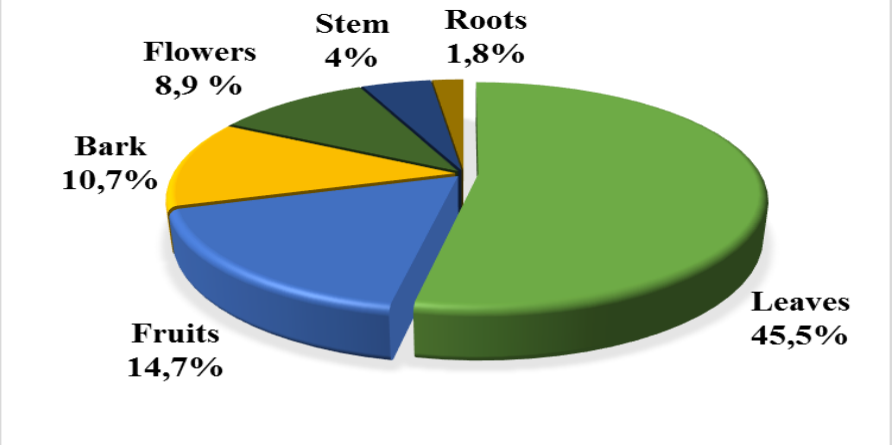

Fig. 3. Percentage occurrence of the plant parts used in treating cancer.

3.3. Procedure of preparation

To meet the needs of cancer treatment, the methods of preparation was also included in this work, namely decoction, infusion, fumigation, poultice, maceration, powder or medicinal plants are used raw or cooked. Most of the preparation methods were given by the informers while others were collected from the herbalists and herb sellers.

Among all the methods of preparation, the results demonstrated that the infusion and the powder of the plant were the most usable methods with a rate of 43.3% and 37.5 % respectively. The direct use of medicinal plants (raw) ranks third with a percentage of 11.2 %, followed by maceration (4.5%) and then decoction (3.6%) (Fig. 4).

A similar observation was also observed in Constantine by Ouelbani et al. [15]. However, many authors such as Eddouks et al. [24] reported the predominance of other modes of preparation, such as decoction.

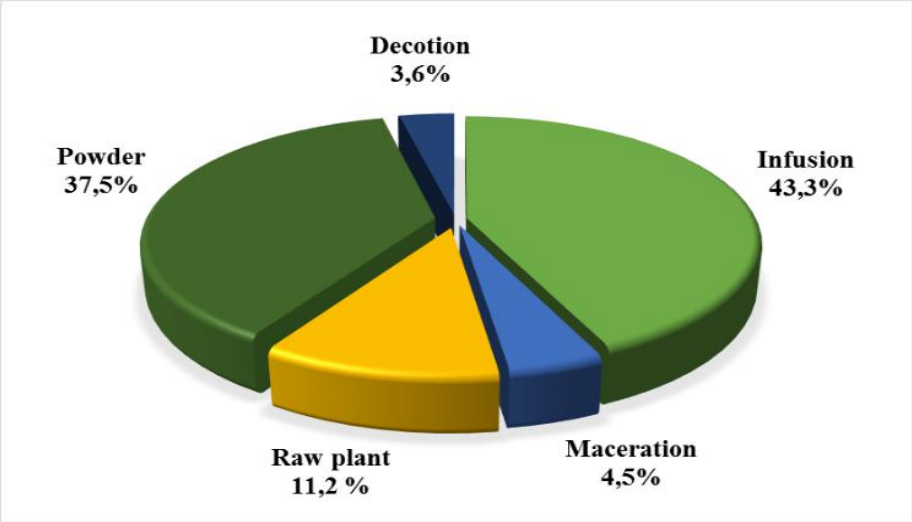

Fig. 4. *Percent of methods of preparation in M'sila province*

3.4. Formulation of the dosage

Information gathered from the users of medicinal plants in the region of M'sila, shows that practically people use medicinal plants with unspecified doses, which may lead to other complications in patients. The advantage of Traditional medicine is that; it is cheaper, readily available, and satisfactory results without side effects. But it is necessary to be careful because the uncertain dose may manifest harmful effects on health because "no substance is poison itself, it is the dose that makes the poison.". For this reason, it is imperative for ethnobotanists, pharmacognosists, and the herb sellers to inform and advise the users about the formulation of the dosage.

Conclusion

In this study, 39 species of medicinal plants collected from M'sila steppe (North east-Algeria), have been found efficient in the treatment of diseases with cancer symptomatology. The studied plants were subjected to ethnobotanical survey by interviewing the local inhabitants. However, the most known and used species in the region were *Ephedra* alata subsp. alenda, *Annona muricata, Berberis vulgaris, Artemisia herba alba, Nigella sativa, Trigonella foenum, Ziziphus spina-chisti, Peganum harmala L.*

The encountered medicinal plants were subjected to ethnobotanical survey by interviewing the local inhabitants. Results show that the leaves are the most used parts (45.5%), by infusion or as powder (43.3 % and 37.5 % respectively).

Despite the extended use there are a few research and no clinical experiments published on the medicinal plant's effectiveness against cancer. For that it is suggested to increase the number of scientific studies and it should be processed to clinical trials with the plants from M'sila, which can help to improve the Algerian health system. In this work, it is suggested also to control the anarchic use of the mixture of plants with uncertain doses which may lead to other complications and needs to be dealt seriously with it. It is preferable or even indispensable that any kind of treatment by medicinal plants should be addressed by the government.

Acknowledgements

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USES PROFILE OF MEDICINAL PLANTS BY THE PEOPLE IN THE RURAL AREA OF BOUSAADA, (MSILA PROVINCE, SOUTH EST OF ALGERIA

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Abstract: *This study aims to know the different uses of medicinal plants collected for medicinal purposes by the local people of Bousaada (Msila province, Algeria). Semi-structured interview questionnaires were used to collect and provide significant ethnobotanical information on the plants used. The most widely used plants by the local population in the traditional medicine are mainly Artemisia herba-alba, and Juniperus oxycedrus. A total of 534 person were interviewed, most are women over 60 years old, with a middle level of education, the most frequently used parts of plants for the treatment, was leaves (33%) followed by seeds and fruits, the infusion (23%), followed by decoction (20%), were represent to be used more, while, the most treated disease was gastrointestinal disorders with a rate of 31.2%. Our study provided an opportunity to access and know about the traditional uses of the inhabitants of Boussaâda, and showed that in the Bousaada the folk use of plants still derives from daily practice. So, evaluation of pharmacological activity for the important medicinal plants is suggested..*

Keywords: *Ethnobotanical, medicinal plants, Bousaada, Msila, Algeria*

1. Introduction

Historically, the use of herbs for treatment dates back more than 60 000 years back to the Stone Age [1], and written evidence of medicinal plant use in drug preparation was found on Sumerian clay slabs from Nagpur about 5 000 years ago [2]. Many herbs that humans have used in the past are either for diseases or seasoning food, so it is sometimes difficult to distinguish between the use of spices in cooking or response to the risk of food-borne pathogens. The World Health Organization assessed the proportion of alternative medicinal users worldwide to more than 80 % of the world's population particularly those with limited incomes. According to Sangare, [3], there are factors which make this percentage, among them: the geographical and economic inaccessibility to modern health care, the inadequate and poor distribution of health personnel, as well as socio-cultural behavior.

The WHO, demonstrated that about 25 % of modern medicinal products were derived from plants [4]. As the pharmaceutical industry deserves to note, vegetation is based on the use of plants in alternative medicinal products and their effectiveness as a treatment. However, the use of plants as a source of new drugs is still being explored at a slow pace despite scientific and technological advances in the pharmaceutical industry. In the plant species estimated at 250 000–500 000, only a small percentage of phytochemicals have been examined, but more than a small percentage of them we can say that they were studied correctly and accurately in terms of their pharmacological properties; in most cases, only a preliminary drug examination or initial studies at the latest [5].

The interest in traditional medicine, particularly herbal remedies in Algeria, is still relatively poor even with the vast area of Algeria, estimated at 2.382 million square kilometers, and its enormous natural resources spread in various habitats (coastal, hilly, desert) and its wide variety of vegetations. Furthermore, the displacement and urbanization of rural farmers present a major risk of losing and ignoring the cultural heritage of plants used in alternative or traditional medicine [6].

Majority of the Bousaada people living in rural areas traditionally use plants. Generally, they use plants for nourishment and medical purposes. In recent years, traditional use of plants for medical treatment has drawn the attention of researchers in Algeria as well. This investigation identified not only the important plants used for medical purposes by informants, but also the uses profile of these plants.

2. Materials and Methods

2.1. Study area

The study area is located in the province of M'sila, it is located in the South-East of Algiers (N 36° 42' 13", E 6° 51' 23") (Fig.1). At about 260 km; it contains five municipalities: Mdjedel, Temsa, Menaa, Slim and Bousâada (**Fig.1**). It extends over an area of 2257 km^2; it includes a global population of 210 181 inhabitants [7]. Geographically the study area is limited to the North by the Hodna Mounts, to the South by the Ziban Mounts, to the east by the Belezma Mounts, and to the West by the Ouled Nail Mounts [8]. The physical structure of the whole province is very heterogeneous. The local economy of Bousâada is based on agropastoral and tourist vocations essentially inherited from the French colonial era [9].

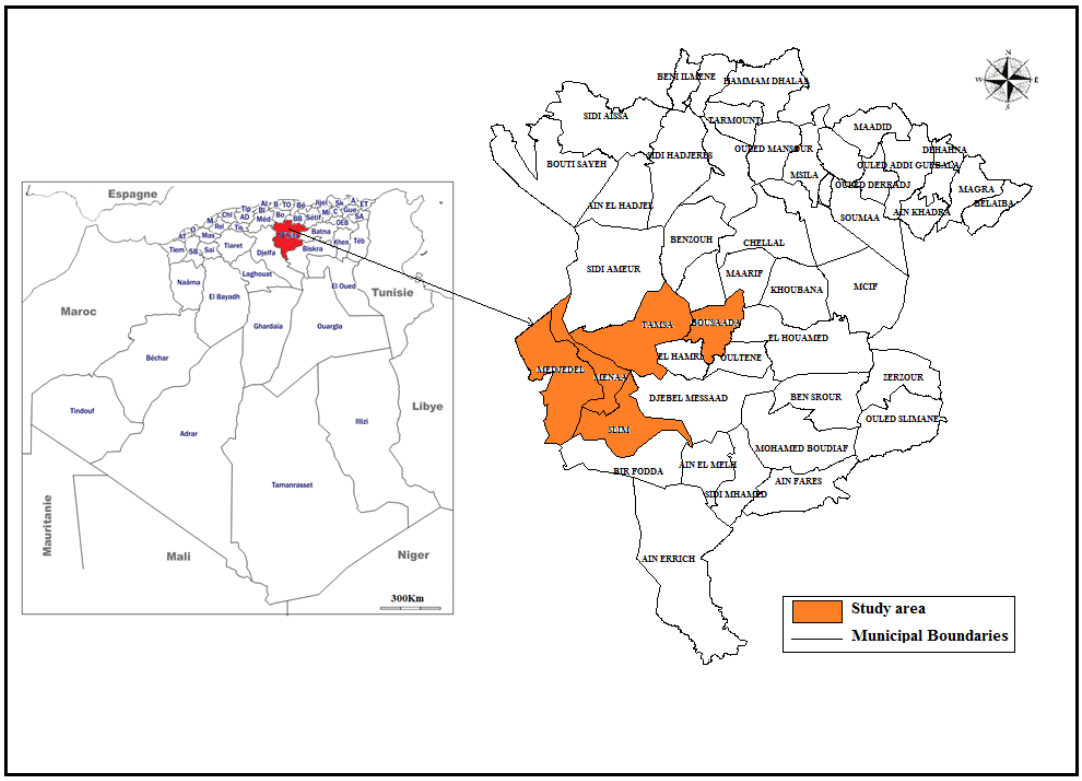

Fig.1. *Location of study area (Rural regions of Bousaada; South Weast of Msila province, Algeria) (Municipalities of Mdjedel, Temsa, Menaa, and Bou Saada)*

2.2. Ethnobotanical surveys

Using 534 questionnaires record, ethnobotanical surveys were conducted face to face [10]. During the period of two years (2020-2022), the users of medicinal plants in the rural towns of Bousaada were interviewed using simple stratified random sampling. In addition, ISE code of ethics (www.ethnobiology.net/ethics.php) was followed and the interview was done without pressure to permit the participants to respond naturally [11]. In this work, the questionnaire was about the profile of the questioned individuals including

educational level, gender, age, monthly income, the origin of information, and preferred care, and the second part concerning the uses of the plants including methods of preparation, therapeutic uses and plant organs use. The approval of local knowledge holders to participate in the questionnaire was obtained as referred by the International Society of Ethnobiology [12].

2.3. Data analysis

The recorded data were reassigned to our internal database using common software (Excel) prepared by ourselves, then were analyzed and compared with numerous national and international ethnopharmacological references (articles, books, reviews in electronic databases: Science Direct, PubMed, and Google Scholar) to identify the similarities, differences, and new uses of unknown and well-known medicinal plants.

3. Results and discussion

3.1. User's sociodemographic profile

According to our results, both sexes women and men exercise traditional medicine. However, woman predominates with a percentage of 76% (Table 1). This can be explained by the fact that women are more concerned with processing and preparing herbal recipes, for themselves and also for the whole family. According to the previous studies in Algeria, all authors concluded that Algerian women are more familiar with the knowledge and treatment of medicinal plants; such as the works of Souilah *et al.* [13], in the National Park of El Kala (El Taref), Bouziane [14] in the region of Azail (Tlemcen), Bendif *et al*. [15] in Bordj Bou Arreridj, Oulebani *et al*. [16] in the region of Constantine and Mila, Adouane [17] in the southern region of Aurès and Aribi. [18] in the region of Jijel. Also in Morocco, this was too observed by Eddouks *et al.* [19] and El Hafian *et al.* [20].

The use of medicinal plants in Boussaâda is widespread in all age groups (Table 1) with a predominance of people over 60 years (36%) and [50-59] years (28%). The age groups [40-49], [30-39] and [20-29] are represented with respectively 15%, 10% and 9% (Table 1). The age group under 20 is represented by 2%. The results obtained show that the elderly have a better knowledge of traditional medicine compared to other age groups. Algerian previous studies were found almost similar to our results, such as the work of Souilah *et al*. [13] in El Kala region, who reported the dominance of the people over 60 years. The comparison of our results with other studies obtained outside of Algeria, shows a similar result, to that observed in Morocco and Egypt (55 and 50 years old), respectively, by Gonzales-Tejero *et al*. [21]. In general, experience accumulates with: age, the transmission of knowledge from one person to another, and through reading and social networks.

People with an average level of education represent the highest rate (31.9%) followed by illiterate's people and primary level (21.8% and 21.6%, respectively). For the other levels university and secondary, the rate of use of medicinal plants was low and hovers around 11.8% to 12.9%, respectively (Table 1). This is probably due to the desire of young people to try natural therapies.

These results were similar to other authors in Algeria such as Amrouni [22] in Serraidi (Annaba), Miara *et al.* [23] in Tiaret, Bendif *et al*. [15] in El Mansourah and Souilah *et al*. [13] in El Kala National Park, which showed that the illiterate represented the high rate of medicinal plant use.

The local economy of the studied area of Bousâada is based on traditional agriculture and intensive livestock production for home consumption. and this explains why the unemployed are moving towards phytotherapy with a percentage of 34.28% of the total users of medicinal plants. These results showed that the unemployed research to avoid or minimize the costs associated with seeing doctors and purchasing medicines. The rate of users of medicinal plants is not negligible also among people who have an income below 15 000 AD (18.93%).

On the other hand, we noted that the lowest rate is recorded among the population with an income above 50 000 AD (7.14%). While among people with incomes between [25 000-35 000], [15 000-25 000] and [35 000-50 000] AD the rate of use of medicinal plants varies between 16.43%, 13, 93% and 9.28%, respectively (Table 1). These results are similar to those obtained in Algeria by Amrouni [22], Bendif *et al*. [15] and Souilah *et al*. [13].

Regarding the origin of the information acquired on medicinal plants in the study area, we find that most of the population refers to the family member and the experiences of others, with respectively 33.57% and 30.36%; this reflects the image of the relative transmission of traditional experiences and practices from one

generation to the next. While 20% and 15.07% of people refer occasionally to the information and themselves by consulting traditional medicine books (Table 1). These results confirm those obtained in Algeria by Amrouni [22] and Souilah *et al*. [13].

Table 1. *Informants sociodemographic profile*

Factor	Categories	%
Sex	Men	24
	Women	76
Age	< 20	2
	[20-29]	9
	[30-39]	10
	[40-49]	15
	[50-59]	28
	≥ 60	36
Study level	Illiterate	21.8
	Primary level	21.6
	Middle level	31.9
	Secondary level	11.8
	University level	12.9
The income per month (DA)	Unemployed	34.28
	< 15 000	18.93
	[15 000-25 000]	16.43
	[25 000-35 000]	13.93
	[35 000-50 000]	9.28
	≥ 50 000	7.14
Origin of the information	Family member	33.57
	Other people	30.36
	Books	15.07
	Occasionally	20
Family situation	Single	44
	Married	52
	Divorced	3
	Widowed	1
Prefered care	Traditional therapy	46.07
	Medical therapy	53.93
Habitat Area	City	22
	Town	8
	Companion	70

The family situation reflects the use of medicinal plants, we found that the majority of people who used medicinal plants are married (52%), and the results may be explained by the minimization of the costs associated with seeing doctors and purchasing medicines for the family members. Followed by the single (44%), and the lowest values were found by the divorced and widowed people (3% and 1%) respectively (Table 1).

The analysis of the collected data shows that the majority of the local population prefers to use medical therapy 53.93%, while, 46.07% prefer traditional therapy (Table 1). These results maybe explain why the majority of people think that medicinal plants cause effects side and toxicity. Analysis of the collected data shows that 70% of the population who use medicinal plants are from a companion, followed by 22% from the city while the rate of town population was only 8% (Table 1). These results showed that the habitat area reflects the uses of medicinal plants because the companion area allows the availability of medicinal plants in their environment.

3.2. The parts used in the plant

The results of this study have revealed that some plants were prepared using more than one method. Leaves are reported to be the most frequently used parts of plants for the treatment,

constituting about 33% of the preparations, followed by seeds and fruits constituting 13%, while stems and aerial part contribute with 12 and 10%, respectively of the herbal preparations, while, the whole plant, flowers, cortex, roots, rhizome, and others parts contribute about 1 to 6 % of the herbal preparations (Fig. 2).

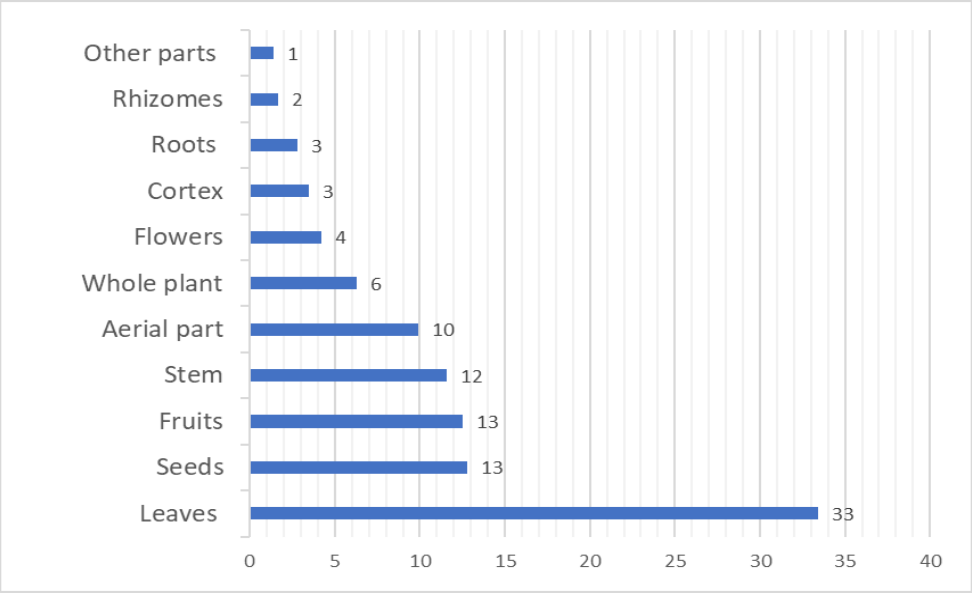

Fig. 2. *Use frequency of different parts of medicinal plants (%)*

Leaves preparations have also been observed by several authors in different regions of Algeria (Amrouni, [22]; Chermat and Gharzouli, [24]; Ouelbani *et al*. [16]; Bouasla and Bouasla, [25]; Bendif *et al*. [15,41]; Miara *et al.* [26]; Souilah *et al.* [13]; Miara *et al.* [6] and with other studies in Mediterranean regions Parada *et al.* [27]; Tuttolomondo *et al.* [28,29], Carrió and Vallès, [30]; Guzel *et al.* [31]; Eddouks *et al.* [19].

This high importance of leaves use can be explained by the ease and speed of harvesting [32, 33]; the abundance compared to other parts [34], and ease of conservation [35], but also by its impotence as the site of photosynthesis and sometimes of the storage of secondary metabolites responsible for the properties of plant life [36].

3.3. *Methods of preparation*

For the application of the treatments of the various symptoms mentioned above, we have encountered various forms of preparations, the most widely used of which is an infusion with 23%, followed by decoction with 20%, macerations and powder represent a rate of 19 and 18% successively, other methods, with 11%, and with little importance, the preparations like juice, ointment, and poultice with: 5, 4 and 3%, respectively (Fig. 3).

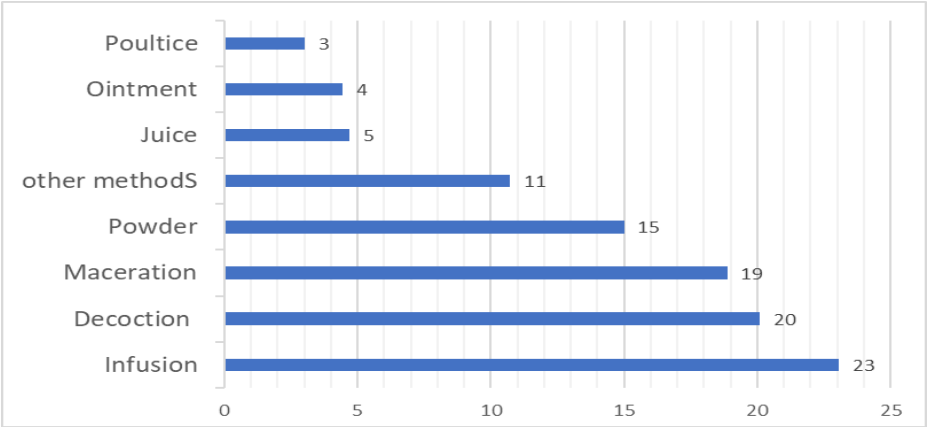

Fig. 3. *Use of medicinal plants according to the method of preparation (%)*

The dominance of the method of preparation by infusion has also been observed in previous ethnobotanical surveys carried out in Algeria and other regions of the world: Parada *et al.* [27]; Tuttolomondo *et al.* [28,29]; Hammiche and Maiza, [37]; Guzel *et al.* [31]; Ouelbani *et al.* [16]. However, many others such as Eddouks *et al*. [19] in Morocco reported that a decoction was the dominant method of preparation. The best use of a plant would be that which preserves all its properties while allowing the extraction and assimilation of the active ingredients [38].

3.4. Therapeutic applications

Ethnobotanical analysis has identified several diseases treated by medicinal plants (Fig. 4) a number of diseases treated by medicinal plants.

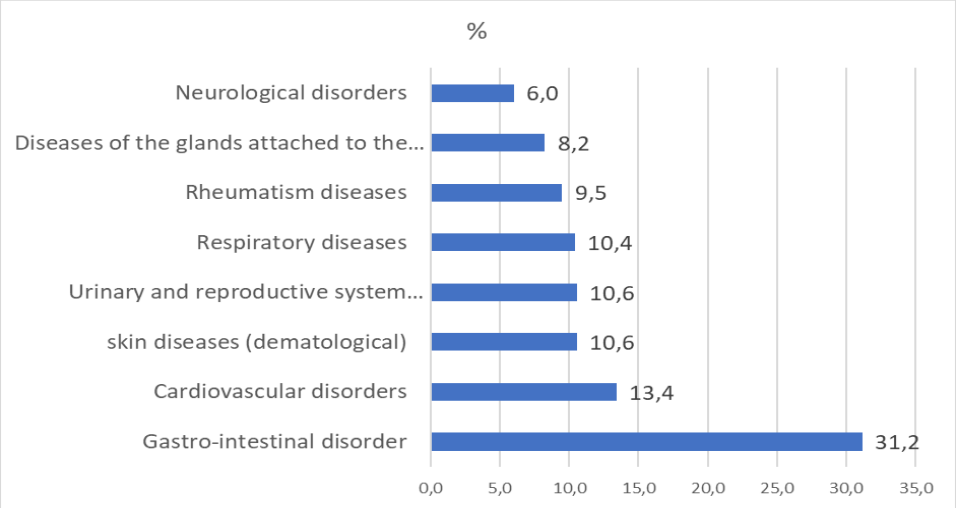

Fig. 4. *Use of medicinal plants according to the therapeutic applications (%)*

In general, the results obtained show that the most treated disease is gastrointestinal disorders with a rate of 31.2%, these results was similar to that observed in a majority of the ethnobotany study in many Mediterranean areas. In second position is cardiovascular disorders with a percentage of 13.4%, followed by skin and urinary disorders with a rate of 10.6% for each one and respiratory with 10.4%, so that last position we note the rheumatism, diseases of the glands attached to the digestive system and neurological diseases.

Conclusion

Boussaâda is an important area for medicinal plants and associated local knowledge. The mostly used plants by the local population in herbal medicine are principal: *Artemisia herba-alba*, *Juniperus oxycedrus*, *Mentha viridis*, *Thymus vulgaris*, and *Artemisia vulgaris.* More than 50% of inventoried plants are available in the spring time. According to the habitat, spontaneous plants are the most important for the majority of the uses in traditional medicine (53%). The cultivated plants constitute 45%, while the exotic ones are the least used (2%). The ethnobotanical study carried out on the study site highlighted the important place of traditional herbal medicine in the lifestyle of the inhabitants of Boussaâda.

The information gathered through 534 survey sheets reveal that women over 60 years old (36%), with a middle level of education, are the most likely users of folk medicine. The investigation revealed that leaves seem to be the most frequently used parts of plants for the treatment (33%). This survey provided an opportunity to access and learns about the traditional practices used by the inhabitants of Boussaâda. Although this know-how appears wealthy through the obtained results, it might be more worthwhile to extend such investigations to other areas of the country to safeguard this invaluable cultural heritage. Thus; the obtained results may serve for phytochemical research to detect the active principles of the studied plants.

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Conflicts of Interest

The authors declare no conflict of interest.

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CONSUMER PERCEPTIONS OF FUNCTIONAL FOODS WITH ANTIOXIDANT AND ANTICANCER POTENTIAL

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Abstract: *The article offers a general overview of the survey conducted among the population of the Republic of Moldova in order to identify the attitude of consumers to functional foods with antioxidant and anti-carcinogenic potential, and their further development and introduction to the market. 150 respondents took part in the online survey. The survey participants were presented with 14 questions from three main groups: social, basic and final. The results of the survey revealed that, despite the active development and introduction of functional food products into public catering production, most of the respondents, 41%, do not have sufficient information. Detailed study of nutrition in cancer and functional products in general (74%) It is important for the respondents, and they (69%) also consider it necessary to expand the range of this group of products in the territory of the Republic of Moldova.*

Key words: *consumer perception, functional food, antioxidant and anticancer potential, technological process and food development.*

1. Introduction

For the first time the term "functional food products (FFP)" appeared in Japan in the 80s of the XX century. The leaders in their production are the UK, Japan, China and the USA (Arai, 1996). Despite the amazing achievements of scientific and technological progress, human nutrition has deteriorated significantly (Young *et al.*, 2000). With the active development of public catering enterprises, especially establishments specializing in fast food, people stopped caring about the quality of their diet (Küster-Boludaa *et al.*, 2017).

It is important to learn how to properly evaluate the consumed products by the criterion of their digestibility by the body, it is also necessary to understand how these or other products are useful for all internal processes. Majority of people have discounted the importance of a healthy, balanced diet (Hong *et al.*, 2020).

However, it is nutrition that can cause diseases such as obesity, diabetes mellitus, and also leads to the formation of plaques on the walls of blood vessels and the development of cancer (Siddhita *et al.*, 2021). According to statistics, every year more than 5 million people become victims of cancer (WHO, 2020). Malignant tumors have become one of the main causes of mortality in the population (WHO, 2020; Halliwell *et al.*, 2009).

This topic is more relevant than ever today, people who are faced with a diagnosis of "cancer" especially need proper nutrition (Nestle *et al.*, 1996; Nazer *et al.*, 2019). Due to insufficient intake of essential nutrients, a person's condition may worsen, the disease will progress (Birben *et al.*, 2012; Langseth *et al.*, 1995).

On the territory of the Republic of Moldova, there is an extremely poor assortment of FFP with antioxidant and anti-carcinogenic potential, taking into account this information, the main goal of the study was set: to assess the possibilities of further adaptation of this group of products, to study consumer awareness, trust and attitude to FFP.

2. Materials and methods

2.1. Survey respondents

The survey was conducted among residents of the Republic of Moldova online. Participants were offered 14 questions to study. The study involved 150 respondents over the age of 18, and mostly students and teachers of the Technical University of Moldova. Analyzing the results of the survey, presented in more detail in Chapter 3, all the survey participants were classified according to certain criteria:

- actualizers, these are those who have an open view on the emergence of new foods with antioxidant and anti-carcinogenic potential, this group of respondents mainly includes the female half of the population, over 30 years old;
- consumers with conservative views, they are not ready for radical changes, they will hardly change their habits regarding food and products, pensioners and respondents who reacted neutrally to the topic under discussion entered this category;
- experimenters, those who follow innovations and more often purchase food products thoughtlessly, they include young people, up to 20 years old.

2.2. Research methodology

Within the framework of the study, a qualitative method was used to study the perception of the population of the Republic of Moldova regarding functional foods with antioxidant and anti-carcinogenic potential. The method of questioning consumers makes it possible to more effectively assess the situation regarding the needs of people in this group of products, and it is also possible to make a forecast for their further development in the country.

When conducting the survey, the main research directions were applied:

- analysis of consumers by age category, gender, social category;
- analysis of consumers' attitude to healthy eating, as well as their willingness to abstain from harmful habits;
- study of the level of awareness of the population regarding the impact of nutrition on human health;
- study of the level of awareness of the population regarding the existence of foods with antioxidant and anti-carcinogenic potential;
- analysis of the attitude of consumers to the creation of functional food products, and their subsequent implementation at public catering enterprises.

2.3. Working research tool

All the questions presented in the questionnaire are formulated mainly in a short form, without complicated turns, for a clearer understanding by all the survey participants, they were also grouped into separate categories and analyzed (Fig. 1., 2., 3.).

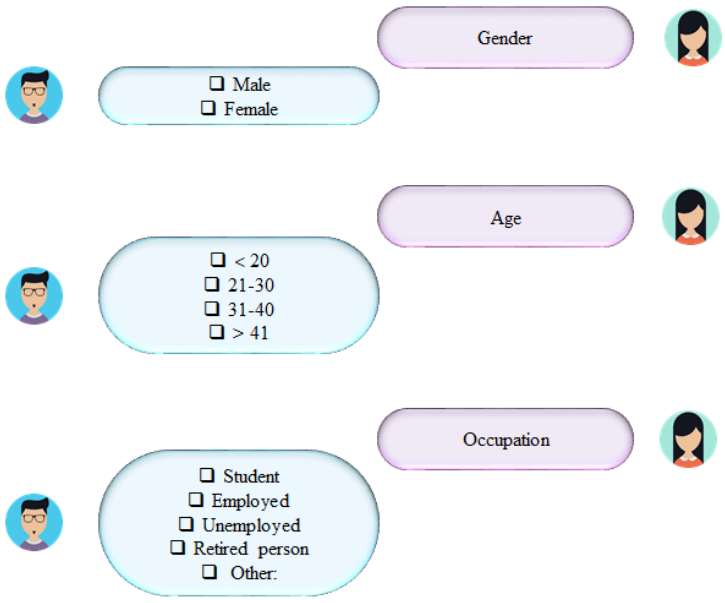

Fig. 1. *1st group: Social Questions*

The significance of social issues lies in the fact that they allow you to establish contact with the respondent, gain his trust, and they also help to characterize a person, identify which group of the population is more interested in solving the problem.

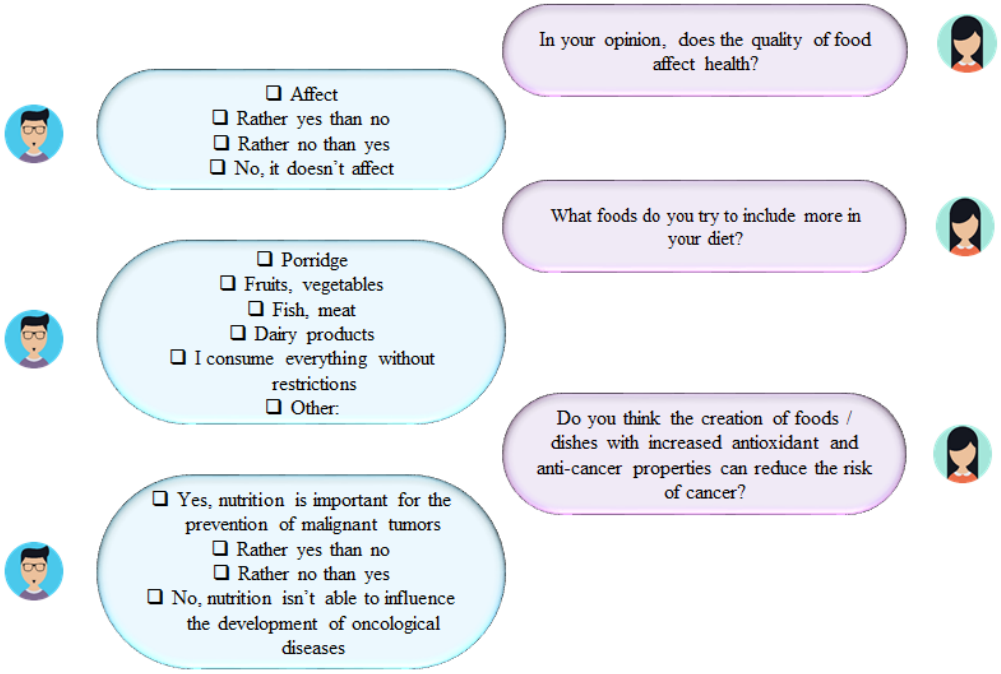

Fig.2. *2nd group: Basic Questions*

This group of questions allows you to get information about the respondents' attitude to nutrition in general, and it is also possible to identify how consumers are aware of functional foods with anti-carcinogenic and antioxidant potential.

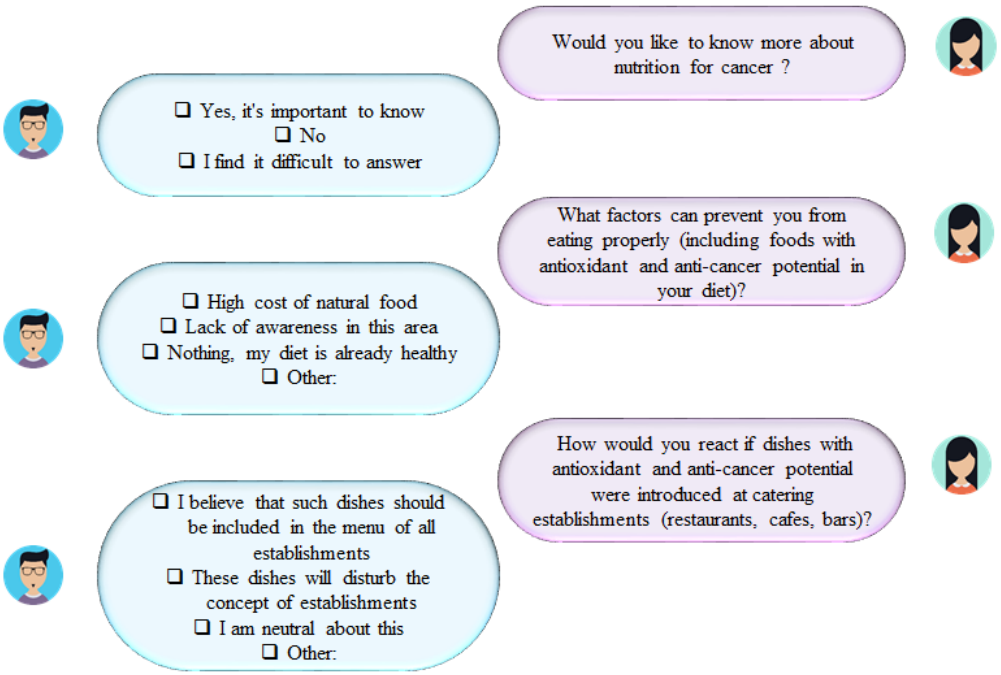

Fig. 3. *3rd group: Final Questions*

The final questions in the questionnaire are necessary to supplement the respondents' personal data, in this study, the third group of questions makes it possible to analyze the perception of each participant in the questionnaire regarding the creation of functional food products on the territory of the Republic of Moldova, as well as the willingness of the population to include them in their diet.

When compiling the questionnaire, it was important to preserve the logical relationship between the questions and answers, to prevent their ambiguity. To conduct further research, it was expected to determine the level of interest of the population in the existence and creation of food products with anti-carcinogenic and antioxidant potential, to understand their beliefs in the field of nutrition in general.

3. Results and discussion

3.1. Social Questions

As an introductory part, all respondents were asked to indicate their gender, age and occupation.

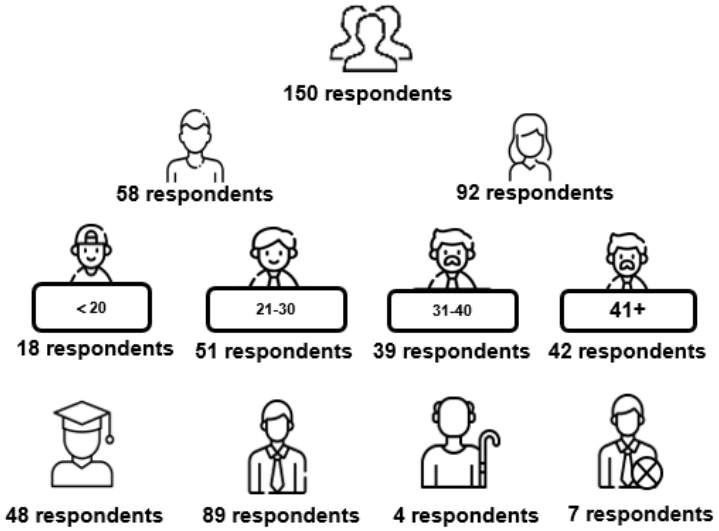

Fig. 4. *Results of the respondents' analysis*

92 (61%) of the 150 respondents represent the female half of the population, 58 (39%) of the participants are men. The main percentage of respondents (51, 34%) belongs to the age group of 21-30 years, followed with a small difference by the age groups of 31-40 years (39, 26%), 41 and older (42, 28%). Young people under 20 were less interested in the topic under discussion (18, 12%).

More than half of the respondents (89, 59%) are engaged in labor activity, a significant number of students (48, 32%) also took part in the survey, there were only 4 participants among pensioners (3%), 1% (2) – mothers on maternity leave, 5% (7) – people, temporarily, without type of activity.

3.2. Basic Questions

The analysis of the answers to the main questions asked to the respondents allowed to learn more about the nutrition of the population of the Republic of Moldova, to get acquainted with their opinion about functional foods, about their habits. The results are presented in the form of diagrams.

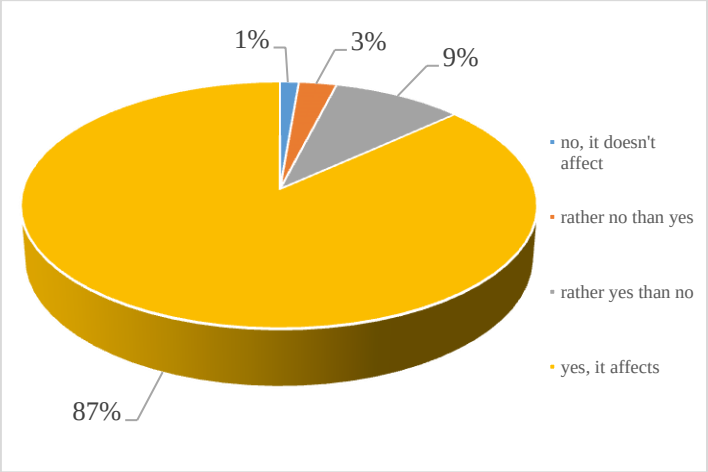

Fig.5. *The results of the analysis of consumers' perception of the impact of food quality on health*

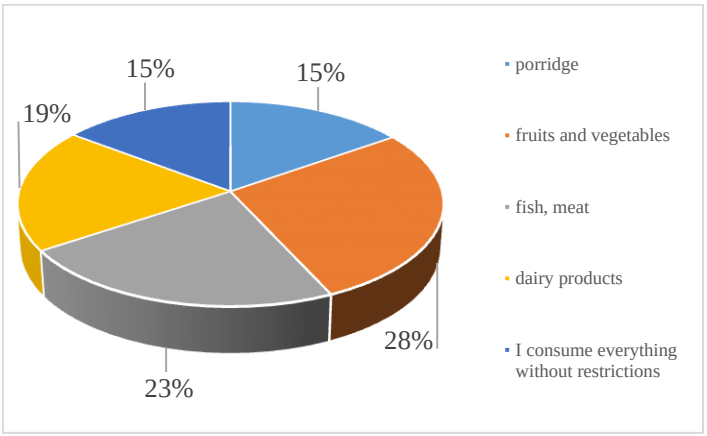

Fig. 6. *The results of the analysis of food groups that predominate in the diet of respondents*

130 (87%) respondents see a relationship between the food consumed and its impact on the quality of health. However, their understanding of the importance of nutrition slightly does not correspond to the products used in the diet.

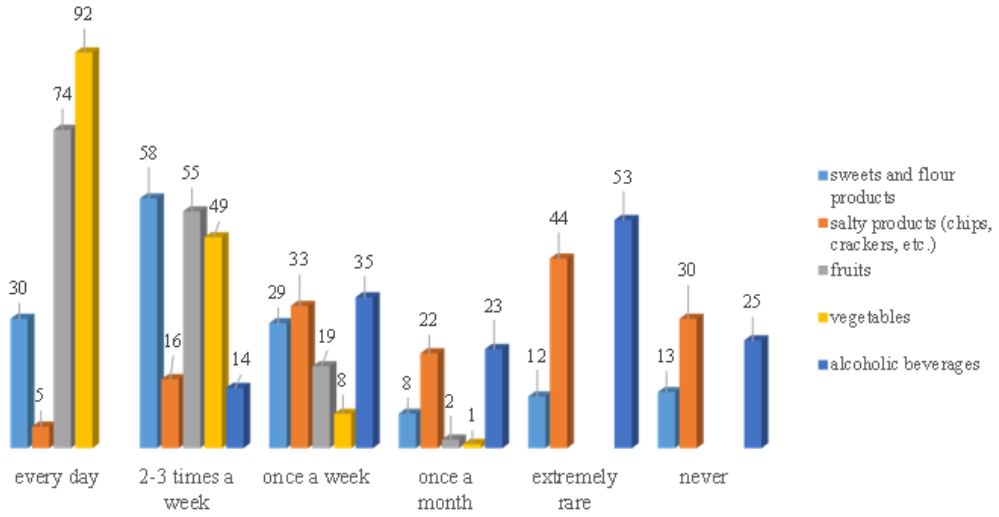

Fig. 7. *The results of the analysis of the frequency of respondents' consumption of certain food groups*

In general, from the respondents' answers, it can be concluded that they monitor their diet by including fish, meat, mostly fruits and vegetables, dairy products in the menu, nevertheless, out of 150 people, 30 consume flour and confectionery products daily. Within the framework of the survey, this value may not seem so impressive, since it is only 20% of all participants, if these percentages are correlated with the entire population of the Republic of Moldova (2,597,107 people, according to statistics), then, presumably, 519,422 people include sweets in their diet every day, which leads to the appearance of overweight, and, subsequently, may cause the development of malignant neoplasms.

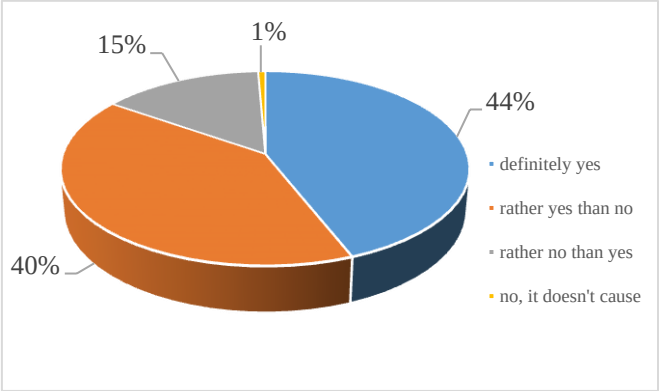

Fig.8. *The results of the analysis of respondents' perception of the impact of nutrition on the development of oncological diseases*

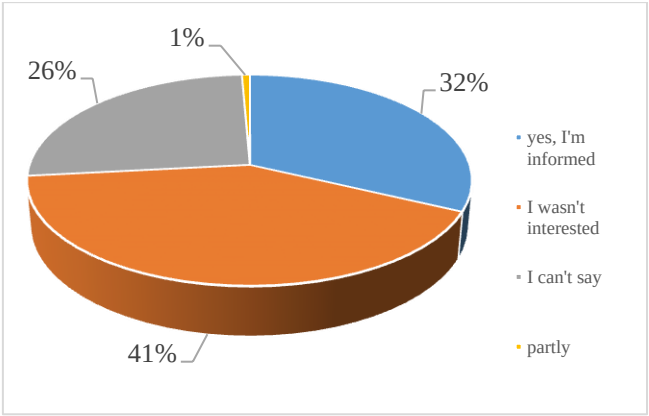

Fig.9. *The results of the analysis of respondents' awareness of foods with antioxidant and anti-carcinogenic potential*

The survey participants were asked whether they believe that food products lead to cancer, the results showed that 66 (44%) of respondents are confident that they do. 61 (40%) of respondents also believe that there is a relationship between nutrition and malignant formations, but this is not unambiguous, 22 (15%) people are more inclined to believe that nutrition does not have a direct effect on tumor development and only one person is sure that there is no relationship.

There is an extremely small number of autochthonous functional food products on the RM market, but the demand for them is growing. One of the reasons for the lack of a rich assortment of such a group of food products is the lack of consumer awareness, from Figure 3.8. it can be noted that 62 (41%) of respondents are not familiar with FFP with antioxidant and anti–carcinogenic potential, 39 (26%) of participants doubt the answer, 1 (1%) - partially has no idea about such a group of products, and only 48 (32%) of the respondents are familiar with the FFP and understand their importance for the body.

3.3. Final Questions

With the exception of nutrition, the main factors affecting the development of cancer diseases also include smoking, alcohol, which

form harmful habits, unlike heredity, they can be influenced, depending on a person's desire.

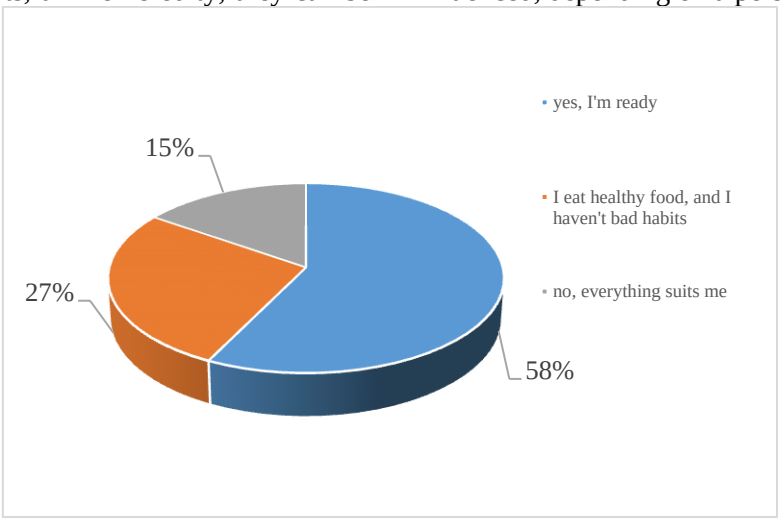

Fig. 10. *The results of the analysis of the level of willingness of respondents to give up bad habits*

It can be noted that 86 (58%) of respondents are ready to give up their bad habits that cannot be combined with proper nutrition, 41 (27%) respondents are sure that their diet is balanced and they have nothing to give up, and 23 (15%) – answered that they do not want to change anything, since they are satisfied with everything. For a more detailed understanding of the reasons for the lack of a wide range of FPP in the territory of the Republic of Moldova, participants were asked to indicate the main circumstances preventing their changes in the diet. According to statistics, the main factor for 63 (42%) of respondents is the high cost of natural products, 52 (35%) of respondents answered that they eat right, for 35 (23%) people, the hindering factor, as previously revealed, is insufficient awareness in this area.

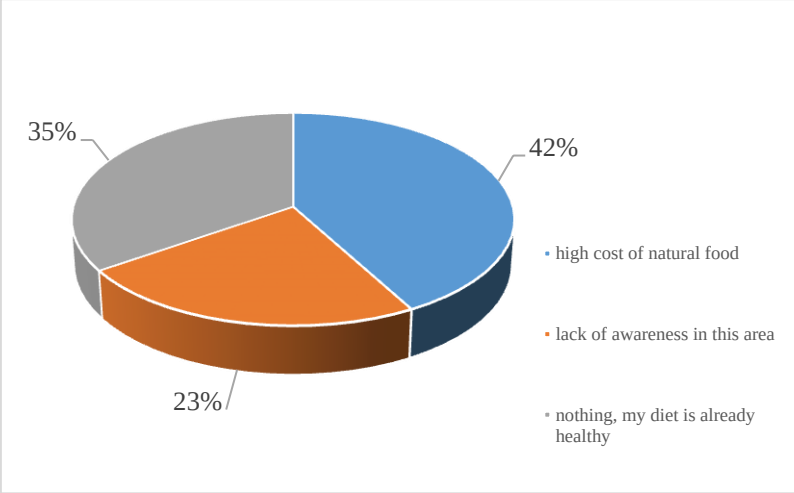

Fig.11. *The results of the analysis of factors that prevent proper nutrition*

Conclusions

As part of the study, a questionnaire was conducted among the population of the Republic of Moldova to analyze their perception of functional products with antioxidant and anti-carcinogenic potential. 150 respondents took part in the survey, 92 (61%) – representatives of the female half, 58 (39%) – men, whose age is mainly (51, 34%) 21-30 years, followed by age groups of 31-40 years (39, 26%), 41 and older (42, 28%). Young people under 20 were less interested in the topic (18, 12%).

The survey revealed: 130 (87%) respondents believe that the quality of products has a direct impact on human health, causing diseases, including cancer. Also, analyzing the preferences of consumers in food and in the frequency of their consumption, the result was obtained that 30

respondents out of 150 consume sweets and flour products daily, which subsequently leads to the appearance of excess body weight, and then can lead to the development of cancer.

Insufficient awareness of functional foods with antioxidant and anti-carcinogenic potential, which is present in 62 (41%) of respondents, is one of the main factors hindering the observance of proper nutrition. Nevertheless, 111 respondents consider it important to obtain detailed information about nutrition for oncological diseases, about functional products in general, and also consider it necessary to expand the range of this group of products on the territory of the Republic of Moldova.

Detailed information about nutrition for oncological diseases and functional products in general is important for the respondents, and they also consider it necessary to expand the range of this group of products on the territory of the Republic of Moldova.

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CONTRIBUTION TO THE FLORISTIC STUDY OF THE BOUTALEB MASSIF: PROPOSAL OF A DEVELOPMENT MODEL

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Abstract: *The Boutaleb massif is a massif located in the Hodna Mountains constituting a hinge between the high plateaus of Setif and the Saharan atlas. The Boutaleb massif extends from an altitude of 700m in the south at the edge of the forest. The work carried out in the Boutaleb massif clearly demonstrates the presence of phytosociological classes of degradation, one cites the Onido-Rosmarinetea class; the class of Lygeo-Stipetea, the plant groups within each phytocenosis, corresponds to a stage in a regressive series of vegetation and the relationship which then binds these groups, is of a dynamic order. This study made it possible to make a floristic inventory of the whole massif: the flora is very rich, containing more than 338 species and 213 genera, belonging to 54 botanical families. The endemic element is relatively well represented, with 4.30% of the flora of the region (14 species listed). To this is added a significant faunal wealth with 72 bird species, 11 mammalian species and 7 reptile species. The interest presented by these northern plant and animal species at the southern limit of their habitat, hence the need for their protection and the preservation of their ecological habitat, which must be included in a development model which will serve as a to decision makers.*

Keywords: *Massif, Floristic diversity, Model, Endemic, Boutaleb*

1. Introduction

The Mediterranean region is considered one of the world's "hotspots" (an area of great importance) given its exceptional concentrations of biodiversity. However, the unique richness of the region is at risk as biodiversity continues to decline very rapidly due to human pressure leading to habitat fragmentation, degradation and loss and species extinction. As biological diversity decreases, our awareness of its importance increases, highlighting the fact
that urgent measures must be taken at all levels to manage this critical issue in the Mediterranean region.[1]

In an effort to identify the areas of highest biodiversity and most threatened on the globe, conservation biologists have defined biodiversity hotspots, areas of high conservation priority.[2]
These hotspots harbor a high species and endemic richness, and they have suffered significant losses of natural habitats caused by intense anthropogenic impacts on this basis, 10 regional hotspots of Mediterranean biodiversity have been identified [3].
Estimated at 25,000 species or 30,000 species and sub-species, the floristic richness of the Mediterranean region is equivalent to approximately 10% of the higher plants of the globe present on only 1.6% of the earth's surface. [4]

According to Médail & Quézel (1997) [4] ; Véla & Benhouhou (2007) [5] , several regions in Algeria remain poorly explored to this day, including those classified as "hot spots", but also certain biogeographical transition zones between the Tell Atlas, the high steppe plains and the Saharan Atlas.[6]

The Hodna Mountains have a remarkable and original flora; several of its massifs have already been considered as "important areas for plants", namely Djebel Dréat, Djebel Boutaleb, and Belezma. [6, 7] The diversity, the value of this heritage flora, particularly in terms of floristic studies, ecology and ethnobotany are essential [8, 9].

Knowledge of biodiversity and territories begins with their inventory. The inventory of biodiversity in a given territory is a stimulating exercise, combining geographical curiosity and a scientific approach. But it requires experience, skill and method to successfully observe and recognize taxa and approach completeness [10].

The Boutaleb massif has been the subject of many works. The first works were based on the geology of the massif (Brossard, 1866; Peron, 1870; Cotteau et al., 1884; Ficheur, 1893; Savornin, 1920; Bertraneu, 1952 and 1955).

Studies that are interested in the flora and vegetation of this region have been less important than that of geological studies. Initially, these studies were limited to the discovery of a few endemic species or which were not reported in Algeria, the time of the first surveys of this massif [11, 12, 13].

2. Methodology

The Boutaleb massif is a massif located in the Hodna Mountains constituting a hinge between the high Setifian plateaus and the Saharan atlas (Fig.1), its geographical location plays an indisputable role in defense against the harmful climatic influences in the south and in the arid regions. Currently, this natural barrier is subject to enormous human pressure (grazing, clearing, logging, etc.), thus the interest in participatory approaches and the vision of forward-looking management involve all the actors directly or indirectly acting on the environment.

Solon Boudy (1955) [14] the dominant forest of Boutaleb has not been developed, but the exploitations have been concentrated in the fairly dense and intensified parts, especially during the war.

The Boutaleb massif extends from an altitude of 700 m in the south at the edge of the forest, to 1888 m in the center at Djebel Afghan. It is characterized by significant topographic and floristic heterogeneity.

The bioclimate is semi-arid at low altitudes with cool winters in the north and cold in the south, while sub-humid with very cold winters dominates the altitudinal parts. The dry season lasts five months at low altitudes, and three months at high altitudes.

The Boutaleb forest is essentially made up of spontaneous ecosystems with Aleppo pine (16,100 hectares), cedar (1,300 hectares), holm oak (18,000 hectares) and junipers (540 hectares)

The Aleppo pine forests are generally located on the northern slopes of the plot, and on the southern slopes, these formations are concentrated in the middle but with smaller extensions. Aleppo pine forests have individualized structures, with regular structures in the young stage (saplings, stems and young tall forests) and irregular structures with garden-like and sub-regular patterns in the adult and old stages.

Holm oak forests occupy the central-eastern part of the plot. This species is almost exclusively present in simple (primary) bushes. Pure cedar occupies a relatively large area. But its potential area could be much larger, and it seems to disappear entirely from the southern slopes.

In order to know the floristic richness and diversity of Djebel Boutaleb, the floristic list and the species of medicinal interest of the study area are established from the floristic inventories carried out between the outing campaigns ranging from 2019-2020 during the months of April, may and june, in several stations.

For the determination of the plant species, we used the new flora of Algeria of Quézel and Santa, (1962, 1963) [12] and of North Africa of Maire (1952–1987) [15] supplemented if necessary by the flora of Corsica by Jeanmonod and Gamisans (2007) [16].

Rarity and endemism in Algeria are informed from the only reference flora for Algeria by Quézel and Santa (1962, 1963)[12]. The analysis of this flora allowed us to bring out a list of medicinal plants in the Boutaleb region, aromatic plants, plants of economic interest (Fig.2, Table 1).

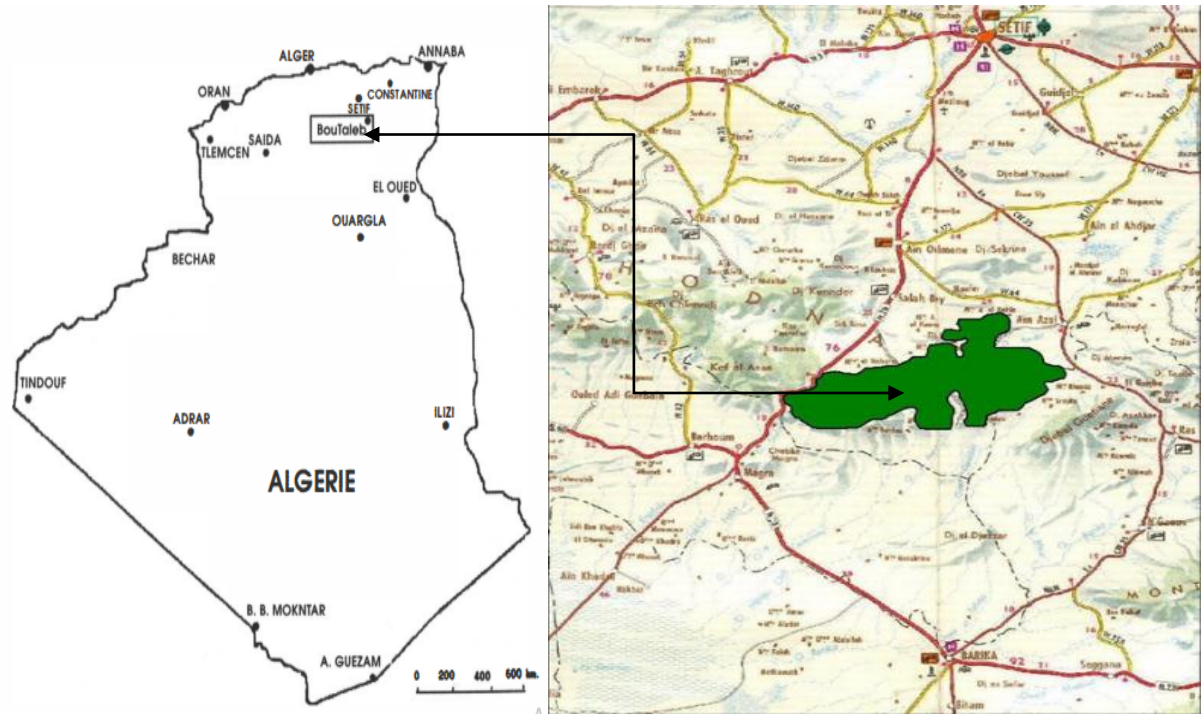

Fig.1. *Geographical location of the study area of the Boutaleb Forest*

Table 1. *Simplified diagram of the distribution of forest formations in the Boutaleb*

Bioclimatic floor / **Vegetation stage**	**Semi-aride 300>P<600 mm/an**	**Sub-humide P>600 mm/an**
Alti-mediterranean 1750m<Alt <1888m	Lawn skinned thorny xerophytes	
Oro-mediterranean 1400m<Alt<1800 m	*Cedrus atlantica* Manetti.	*Quercus ilex* L.
Meso-mediteranean 1300 m<Alt< 1500 m	*Quercus ilex* L.	*Pinus halpensis* Mill.
Thermo-mediteranean 1000m<Alt<1300 m	*Phillyrea angustifolia* L. *Pistaciz lentiscus* L. *Juniperus Phoenicia* L. *Ampelodesma mauritanica* Pir. Dur. *Rosmarinus tournefortii* Noé. *Globularia alypum* L.	*Pinus halpensis* Mill.

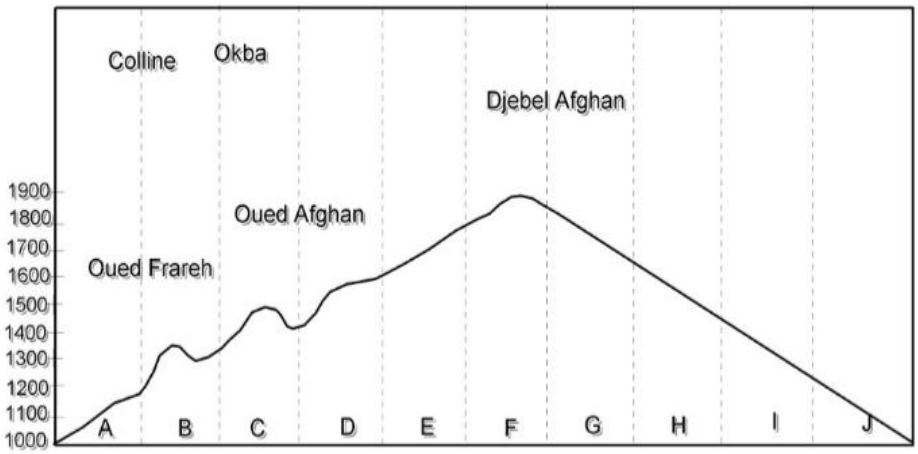

Fig.2. *Spatial distribution of spontaneous vegetation along a north-south transect Djebel Boutaleb*

- **A.** Matorral a *Pinus halepensis* Mill. et *Quercus ilex* L.
- **B.** Matorral a *Quercus ilex* L.
- **C.** Forêt dense de *Cedrus atlantica* Manetti.
- **D.** Foret claire de *Cedrus atlantica* Manetti.
- **E.** Pelouse ecarchée
- **F.** Matorral arboré
- **G.** Matorral a *Quercus ilex* L.
- **H.** Matorral a *Pinus halepensis Mill.* et *Quercus ilex* L.
- **I.** Foret dense de *Pinus halepensis* Mill.

3. Results and discussion

3.1. Floristic diversity

Field trips and ethnobotanical surveys during the period 2019 to 2020 led to the development of the the floristic richness within the massif with 338 taxa belonging to 213 genera and 54 families.

3.2. Generic richness

The number of botanical families listed is 54: the Asteraceae family has 39 genera, followed by the Fabaceae family, which has 20 genera. With 19 genera, the Poaceae are one of the most well-represented families.

The Brassicaceae and Apiaceae have 14 genera each, Caryophylaceae and Lamiaceae have 10 genera each, and the remaining families have 7 to 1 genera each. With a clear representation of the relationship that binds the genera of the species according to their membership in the botanical families.

3.3.Specific richness

The best represented botanical families are the Asteraceae (50 species), Fabaceae (41 species), Poaceae (32 species), Brassicaceae (22 species), Apiaceae and Caryophylaceae (19 species), Lamiaceae (17 species), Cistaceae and Liliaceae (12 species), the remaining 45 families are each represented by number between 8 and 1 of species (Table 2).

3.4. Endemic species

The inventory carried out at the level of the study area has made it possible to identify 30 endemic species belonging to the phytochorological.

The Fabaceae family is the most represented with 6 species, followed by the Apiaceae family and the Asteraceae with 4 species, the Brassicaceae and the Lamiaceae with 3 species, and the others two or one species (Fig. 3, 4).

Table 2. *Distribution of species in the Boutaleb forest by botanical families*

Botanical families	Number of species	Botanical families	Number of species	Botanical families	Number of species
Asteraceae	50	Resedaceae	4	Aceraceae	1
Fabaceae	41	Cupressaceae	3	Apocynaceae	1
Poaceae	32	Linaceae	3	Caprifoliaceae	1
Brassicaceae	22	Oleaceae	3	Chenopodiaceae	1
Apiaceae	19	Papaveraceae	3	Convolvulaceae	1
Caryophyllaceae	19	Polygalaceae	3	Cypéraceae	1
Lamiaceae	17	Primulaceae	3	Ephedraceae	1
Cistaceae	12	Renonculaceae	3	Euphorbiaceae	1
Liliaceae	12	Rhamnaceae	3	Fagaceae	1
Rubiaceae	8	Abietaceae	2	Globulariaceae	1
Geraniaceae	7	Anacardiaceae	2	Malvaceae	1
Scrofulariaceae	7	Campanulaceae	2	Orobanchaceae	1
Rosaceae	6	Ericaceae	2	Plumbaginaceae	1
Crassulaceae	5	Iridaceae	2	Polypodiaceae	1
Cynarceae	5	Orchidaceae	2	Rutaceae	1
Borraginaceae	4	Polygonaceae	2	Saxifragaceae	1
Dipsaceae	4	Solanaceae	2	Salicaceae	1
Plantaginaceae	4	Valerinaceae	2	Thymeleaceae	1

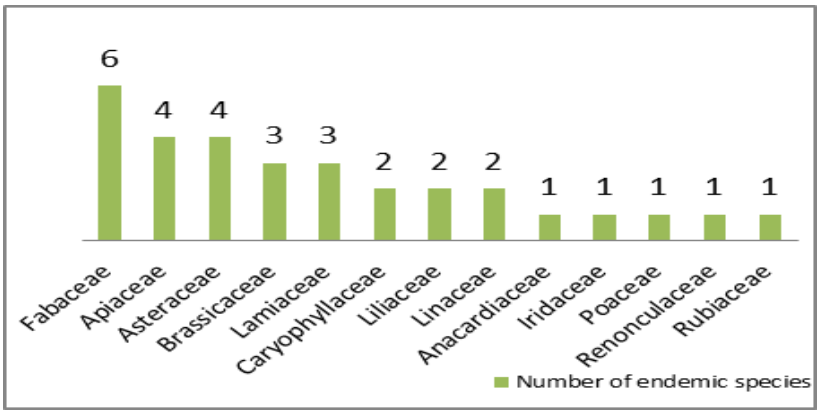

Fig.3. *Number of endemic species per family within the Boutaleb forest*

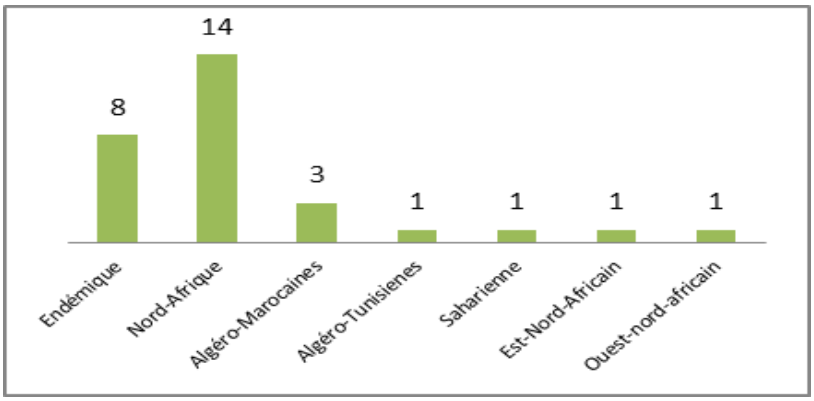

Fig.4. *Level of endemism*

3.5. Rare species

The study area contains 147 rare species belonging to 37 families with rare, fairly rare, very rare and extremely rare abundance.The families of Fabaceae 24, Asteraceae 22, Brassiaceae 16, Poaceae 11 and Apiaceae and caryophylaceae 7 species. Some of these rare species deserved a review of their conservation status, and therefore became placed on the red list from the International Union for Conservation of Nature (IUCN) (Table 3).

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Table 3. *Rare and protected species*

Rare species (IUCN, 1980)	Protected no cultivated species (Decoree No.93-285,1993)
Carum montanum *Hedysarum perralderianum* *Senecio gallerandianus*	*Allium moly* *Cedrus atlantica* *Crupina vulgaris* *Pistacia atlantica* *Senecio gallerandianus*

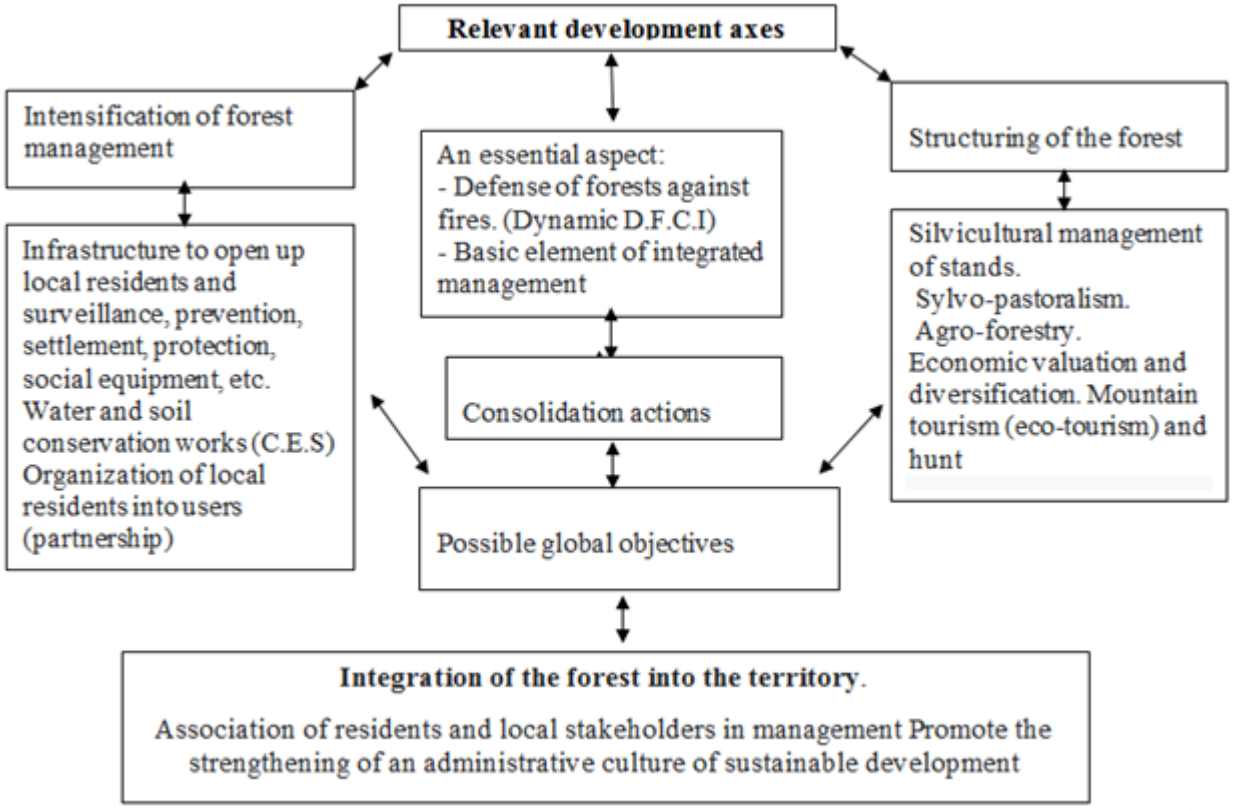
4. Development plan

For sustainable development, natural resources must be managed and conserved to meet the needs of present and future generations. Regarding the forest ecosystem; it is a matter of conserving land, water, plant and animal heritage and enhancing them using technical means that are economically and socially appropriate and respectful of the environment.

Each development action is conditioned by a set of laws defined themselves by ecological and biological studies of all the elements of the territory to be developed.[17] The results of the various floristic, ecological and socio-economic analyzes combined with each other, make it possible to define a management plan.

Daget and Godron (1974) define development as "the organization of space, so as to enhance, through appropriate equipment, the natural resources of the place and satisfy the

needs of the populations concerned". In the forestry domain, planning does not deal solely with the organization of timber harvesting through silviculture planning, but it also seeks projective measures capable of safeguarding natural resources while using their potential [18].
According to the legislation, *Article (37-38-39 and 40)of the law n°84/12 of June 23- 1984*, fixing the methods of installation, exploitation, and management of the forests defines the operation as being the implementation, on the basis of objectives and a plan, agreed in advance, of a certain number of activities and investments, with a view to the sustained production of the forest, without causing adverse effects on the social environment.



Conclusions

The purpose of this study is therefore to mend subsequent work on the same question in order to finalize at least part of the management of the existing heritage of the southern of Setif through the varietal diversity of medicinal plants and aromatics, as well as their various uses local population.
This will be achieved by preparing a development plan, which will serve as a tool for decision-makers to rationally manage this natural heritage on ecological bases to protect the endemic and rare species of the whole study area.

Tables are numbered using Arabic numerals, the table number is placed in the upper-right part, above the table.

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INVENTORY OF ANTI-DIARRHEAL PLANTS IN THE OUANOUGHA REGION (M'SILA, ALGERIA)

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Abstract: *The anti-diarrheal medicinal flora of the Ouanougha region includes 41 species belonging to 20 botanical families and 35 genera. These families are mainly dominated by Lamiaceae (8 species), Anarcadiaceae, Fabaceae, Myrtaceae, Plantaginaceae and Rosaceae (3 species) and eight families containing two species and the other families are represented by one species. The leaves are the most used organ.*
The methods of preparation most frequently employed for the majority of remedies are decoction and infusion.

Keywords: *Anti-diarrheal plant, inventory, ethnobotany, chorology, M'sila, Algeria.*

1. Paper sections and font styles

Medicinal plants continue to meet an important need, despite the existence and influence of modern health systems, about 35,000 species of plants are used worldwide for medicinal purposes, which forms the largest range of biodiversity used by humans [1]. These medicinal plants are important for pharmacological research and drug synthesis not only when their constituents are used directly as therapeutic agent but also as raw material for drug synthesis or model for pharmacologically active compounds [2].

Medicinal plants constitute a precious heritage and a real treasure for humanity, and are in great demand in the world and more particularly in developing countries [3]. These medicinal plants are still a source of medical care in developing countries due to the lack of a modern medicinal system ([4].

Traditional herbal medicine was well developed in Algeria, but the use of conventional medicine is the cause of a neglect of these ancestral practices which risk falling into oblivion [13]. Alongside the programs of some international organizations such as the World Health Union (IUCN) which is interested in promoting the conservation of biodiversity and the sustainable use of natural resources in North Africa, and also the involvement of local communities in the biodiversity conservation [4].

The objective of carrying out ethnobotanical surveys in the Ouanougha region is to obtain a floristic inventory of antidiarrheal medicinal plants used by the population and to collect as much information as possible on the therapeutic uses practiced in the study area. The preservation of this knowledge is a challenge for the conservation and development of resources and this within the framework of the sustainable development of the study area.

2. Materials and method

2.1. Presentation of the study area

The study area is located in the north of the wilaya of M'sila and is limited to the north by Bordj Bou Arreridj and to the east by Hammam Dalaa, to the west by Beni Ilmane and Sidi Aissa and to the south by Tarmount and Sidi Hadjeres (Figure 1).

The Ouanougha region has no weather station. The closest posts are those of M'sila and Bordj Bou Arreridj. The average annual rainfall is 221 mm at the M'sila station, on the other hand it is 385 mm at the Bordj Bou Arreridj station.

The mountainous massifs receive larger quantities of water, of the order of 400–500 mm in the Saharan Atlas and which can reach more than 600 mm in the Monts du Hodna and the Aurès-Belezma [5].

Fig.1. *Geographical location of the study area*

2.2. Ethnobotanical surveys

The ethnobotanical surveys on medicinal plants were carried out between March, April and May 2020 using 188 questionnaires, these surveys allowed us to draw up a list of anti-diarrheal species used by the population of Ouanougha in traditional herbal medicine.

The survey consists of asking questions to the villagers about the plants used in traditional medicine, the parts of the plant used, the methods of preparation, and the types of diseases treated by each plant.

The survey of herbalists makes it possible to draw up a list of spontaneous medicinal plants in the study area and others collected in wilayas bordering the wilaya of M'sila. This survey also allowed us to collect information on the vernacular names of the medicinal plants displayed for sale, the therapeutic uses, the dosage and the diseases treated by each plant.

The survey of traditional healers shows that some family members have significant knowledge of plants of medicinal interest and have healing gifts.

The pharmacological knowledge of plants from traditional healers makes it possible to identify the basic concepts of the perception of the natural environment and the description of diseases [6].

2.3. Questionnaire sheets

The questionnaire sheet is a form made up of two parts, the first is based on the person surveyed (age, sex, level of education and professional situation), the second part collects information concerning each medicinal plant studied, this information makes it possible to evaluate the knowledge of the plant, the use, the prescription and the method of preparation recommended by each of the people questioned.

3. Results and discussion

The results obtained from the ethnobotanical surveys are expressed in technical sheets which consist in highlighting the characteristics of the anti-diarrheal medicinal plants used by the population of the study area and those sold by the herbalists of Ouanougha.

The ethnobotanical survey of medicinal plants carried out with the population of the study area, and the collection of bibliographical data concerning therapeutic uses, allowed us to describe, classify, and inventory the anti-diarrheal medicinal plants, this floristic inventory highlight a floristic richness of 41 species belonging to 20 botanical families and 35 genera. The local population treats diarrhea with the leaves which constitute the most widely used plant organ and with the decoction which represents the most dominant mode of preparation.

The list of anti-diarrheal medicinal plants is presented in the form of a catalog classified according to the alphabetical letter of the botanical families.

***Pistacia atlantica* Desf.** (btem, Arabic; Atlas pistachio) **ANACARDIACEAE**
The leaves and the bark are used, in decoction, against stomach aches and gastric pains. Inhaled, the leaves are used as a febrifuge. The galls are used in powder form, alone or associated with tiger nut as an antidiarrheal and stomachic. Fruits are non-toxic at low doses [7,8].

***Pistacia lentiscus* L.** (drou, Arabian); lentisk, French) **ANACARDIACEAE**
The leaves and the bark are used, in decoction or powder, in the treatment of stomach and intestinal ailments, diarrhea and diabetes. The leaves have emmenagogue, astringent, diuretic, analgesic and antipyretic properties [6].

***Rhus pentaphylla* Desf.** (Tizgha; varnish sumac) **ANACARDIACEAE**
The leaves, roots and bark, in decoction, are used to combat gastrointestinal disorders. The fruits, fresh or dried, are used in the treatment of diarrhea [6].

***Cuminum cyminum* L.** (Cumin; Kamoun) **APIACEAE**
Powdered or absorbed with water, cumin seeds are recommended for diarrhea, menstrual pain and gastrointestinal disorders. As a poultice on the neck, cumin is used against mumps [9].

***Daucus carota* L.** (Cultivated carrot; Jazar or Khizou) **APIACEAE**
Anti-diarrheal, diuretic, depurative, hypoglycemic, aperitif, emmenagogue, remineralising. Cooked or raw, roots or carrots are recommended in case of diarrhoea. They are also used in the treatment of diseases of the urinary tract: renal colic and oliguria. As food, they promote visual acuity [9].

***Chamaerops humilis* L.** (Doum; saw palmetto) **ARECACEAE**
The resin, obtained from the plant, in infusion is deemed hypoglycemic and combats lung ailments [8]. Saw palmetto fruit is used against diarrhea.

***Phoenix dactylifera* L.** (Nkhel; Date palm) **ARECACEAE**
The fruit is renowned as an aphrodisiac and anti-diarrheal. The calcined stones, pounded and sieved, are used for eye care. Dates have undeniable nutritional value. They are fortifying, anti-anaemic, emollient and laxative [10].

***Opuntia ficus-indica* (L.) Mill.** (hendiya; prickly pear) **CACTACEAE**
The flowers, in infusion or better, ingested in powder, are used against diarrhea and hemorrhoids [11]. Non-toxic, but the ingestion of a large number of fruits leads to persistent and sometimes dangerous constipation [8].

***Atriplex halimus* L.** (Legtef; wild orach) **CHENOPODIACEAE**
The powder of the leaves is used against diabetes, pain in the intestines, pain in the kidneys, internal cancer (handful, 1 spoonful/glass). The crushed leaves, in decoction, are used as an antidiabetic and against intoxication. The leaves, in infusion, are used as antidiarrheal. The decoction of the leaves is administered against diabetes, kidney stones and cold (250g/1L) [12].

***Chenopodium ambrosioides* L.** (Mkhinza; Ambrine) **CHENOPODIACEAE**
Leaf powder is used against respiratory ailments and rheumatism. The juice prepared from the fresh leaves of Ambrine combined with orange is used to treat fever (3g/2 oranges). The powder, in decoction, is prescribed against cough, cold, fever and diarrhea (1 spoonful/glass). The leaf powder, in milk decoction, is recommended against fever (handful/glass) [12].

***Arbutus unedo* L.** (Lenj, bakhenti; Arbutus) **ERICACEAE**
The roots in decoction are used against hypertension and liver ailments [8]. Taking some fruits stops diarrhea.

***Ceratonia siliqua* L.** (Kharroub, salghwa; carob) **FABACEAE** The fruits, pulverized, combined with a little water are effective against constipation. A decoction of carobs or pulp freed from seeds is also used in bronchitis. The whole pods or the seeds alone are used mainly to combat diarrhea[6,8].

***Cicer arietinum* L.** (Chickpea; Hamous) **FABACEAE**
Aphrodisiac, invigorating, anti-venom, energetic, diuretic, antiseptic, urinary, vermifuge, emmenagogue, resolving, stomachic, tonic, restorative, antidiarrheal. Externally, chickpea powder is used to make maturing plasters. Mixed with melon or cucumber pulp is used to make softening facial masks. The roots in fumigation, are used there against the pains of the teeth and the gums. The seeds, macerated, are used against jaundice [9].

***Retama raetam* Webb.** (R'tem, retem, Genet blanc) **FABACEAE**
The vegetative part of the plant is healing (skin conditions, especially boils), advised to treat eye irritations, as well as to treat diarrhea, feverish illnesses and tapeworms [13].

***Quercus suber* L.** (Fernan; cork oak) **FAGACEAE**
The pulverized fruits, combined with honey, are used as a stomachic [8]. The bark located below the cork layer is used, under the name d'bagh, in

the regions where the cork oak grows, as a haemostatic and healing agent in the care of wounds, most often in powder form, sometimes in decoction. The powder is also used, orally, as an anti-diarrheal and in the treatment of stomach and colon diseases.

***Quercus rotundifolia* Lam.** (Karrouch; Holm oak) **FAGACEAE**

The roots, in decoction, are effective against fever [8]. In the forest of Achach and everywhere in Morocco, the bark of the holm oak is used in the same way as that of the cork oak, and in particular in the treatment of diarrhea and dysentery.

***Hypericum perforatum* L.** (St. John's wort) **HYPERICACEAE**

Mainly the flowering tops and the leaves are used. In internal use, St. John's Wort is used to fight against bronchitis, asthma, pulmonary ailments, atonic dyspepsia, diarrhea, cystitis, hepatic congestion, white discharge, oliguria, intermittent fevers, ailments origin, neuritis, circulatory insufficiency, obliterating arteritis and childhood infectious diseases [14].

***Juglans regia* L.** (Walnut) **JUGLANDACEAE**

Mainly the leaves, the trunk and the oil are used. Internally, Walnut is used to treat rickets, lymphatism, lymphadenopathy, scrofulosis, asthenia, bone diseases, tuberculosis, chronic bronchitis, diabetes, anemia, gout, rheumatism, diarrhea and tapeworm [14].

***Ajuga iva* (L.) Schreb.** (Ivette or Bugle; Chendgoura) **LAMIACEAE**

Depurative, warming, antidiabetic, vermifuge, anthelmintic, choleretic, hypoglycaemic, astringent, antispasmodic, exciting, anti-diarrheal, appetizer, stomachic, anti-inflammatory, sedative, febrifuge, tonic, antiseptic, eupeptic, vulnerary, hypotensive. In decoction, or in powder added to the dough of bread, the musky ivet is recommended in the event of disorders of the digestive tract, in the event of the painful rules, and at the sterile women. The fresh leaves are pounded and the resulting liquid is heated and administered as a drop against ear ailments [9]. *Ajuga iva* is not toxic, but seems to have a certain sedative power [15].

***Marrubium vulgare* L.** (White Horehound; Merrîwta) **LAMIACEAE**

Antidiabetic, febrifuge, emmenagogue, tonic, expectorant, hypoglycemic, bechic, thinner, cholagogue, aperitif, antiseptic, antipyretic, antidiarrheal, diuretic, anti-cteric, anti-typhoid, stimulant, stomachic, cardiac sedative. In infusion, the horehound is administered in case of asthma, bronchitis, fever, lack of appetite, agitation, insomnia and difficult menstruation. In decoction, it is recommended in case of diabetes, diarrhea, intestinal worms and to beautify the hair. In ear drops, it is used against otitis. As a poultice on the temples, it is used against fever and on burst abscesses and boils in order to bandage and heal them [9].

Horehound essential oil is irritating to the skin and mucous membranes [16].

***Mentha spicata* L.** (N'anā; Mint) **LAMIACEAE**

Mint is used against digestive atony, indigestion, general fatigue, gastralgia, aerophagia, gastric and colic spasms, flatulence, diarrhea, cholera, intestinal parasites, gastrointestinal poisoning, hepatic affections, nervous vomiting, and the fetid breath of dyspeptics. It is also used against palpitations and dizziness, migraines, tremors, paralysis, insufficient or painful periods, asthma, chronic bronchitis, and tuberculosis [14].

***Mentha suaveolens* L.** (Marseta; Round-leaved mint) **LAMIACEAE**

A leaf decoction is highly valued in the treatment of gastric pain, diarrhoea, colds and respiratory ailments. As a poultice or inhaled, the leaves are recommended in case of fever. Abscesses and boils are treated with crushed leaves, or a leaf decoction. This last preparation, in mouthwash, would eliminate dental pain [17].

***Origanum compactum* Benth.** (Za'tar; Oregano with compact inflorescence) **LAMIACEAE**

The leafy stem, in infusion or decoction, is used against gastrointestinal complaints, diarrhea and as a hypoglycaemic. In gargle, it is employed against the affections of the mouth and, in inhalation, against the flu and the cold.

***Rosmarinus eriocalyx* Jord. & Fur.** (Woolly Calyx Rosemary) **LAMIACEAE**

Rosemary would therefore be recommended to treat various cases of asthenia. Leaves ; as an infusion, decoction, poultice or fumigation; are used against diarrhea, hepatic, respiratory (asthma), dermal (hair loss, edema, oily skin, wrinkles), nervous system and osteoarticular system.

***Rosmarinus officinalis* L.** (Azir; Rosemary) **LAMIACEAE**

Rosemary would therefore be recommended to treat various cases of asthenia. Leaves; as an infusion, decoction, poultice or fumigation; are used against disorders of the digestive tract

(diarrhea), hepatic (gallbladder, cholesterol), respiratory (asthma), dermal (hair loss, edema, oily skin, wrinkles), nervous system (depression, memory, migraine , nervousness, sleep) and the osteoarticular system (sprain, rheumatism, sciatica) [9].

***Teucrium polium* L.** (Jaâdiya; Germander) **LAMIACEAE**

The leaves and stems, in decoction, are very popular in the treatment of fevers, gastrointestinal disorders (enteritis, diarrhea, colic), abdominal pain (gastralgia), liver diseases (liver attack, biliary retention) and urogenital diseases. The powdered leaves, combined with henna, are applied to eczema; and fresh as a poultice on wounds [9]. Germander can cause nausea and chronic hepatitis in patients who use it regularly [6].

***Allium sativum* L.** (Thum; Garlic) **LILIACEAE**

Internally Garlic is used in the prophylaxis and treatment of infectious diseases (flu, typhoid, diphtheria), in the treatment of diarrhea and dysentery, lung diseases (tuberculosis, chronic bronchitis), asthma and emphysema, as well than whooping cough. It is also useful in cases of asthenia, cardiac fatigue, in the treatment of certain tachycardias, arterial hypertension, and other circulatory disorders. Garlic is also renowned in the treatment of arteriosclerosis, rheumatism, gout, urolithiasis and to fight against intestinal parasites (roundworms, pinworms, tapeworms) [14].

***Lawsonia inermis* L.** Henna (Arabic), Henna (French) **LYTHRACEAE**

The leaves are used in decoction against gastric pains. Macerated then reduced to a paste, they are used in local application for the treatment of the hair and the beautification of the hands and feet. In addition, the local application of henna is commonly used on eczema, boils, abscesses, cracks and bruises. The leaves are used as an infusion against diarrhea and renal lithiasis [6].

***Myrtus communis* L.** (Rihan; Myrtle) **MYRTACEAE**

Antiperspirant, purgative, tonic, antiseptic, astringent, balsamic, sedative, expectorant, hemostatic, antidiarrhetic. In a drinkable decoction, myrtle leaves are used as a remedy for respiratory ailments, diarrhea, stomach ailments and to treat bad breath in the form of a mouthwash. Compresses soaked in this decoction are applied to wounds, abscesses and bleeding hemorrhoids. The decoction mixed with henna is widely used to darken and soften the hair. The fruit is chewed against gingivitis and mouth ulcers. The infusion is used to treat sinusitis by inhalation 3 times a day [9]. It is low in toxicity. However, its essence can cause headache and depression [18].

***Syzygium aromaticum* (L.) Merr. & LM Perry** (Qronfel, Le Clove, Clove) **MYRTACEAE**

Antiseptic, carminative, stomachic, tonicardiac, diuretic, antibacterial, analgesic, dermacaustic, stimulant, warming, revulsive, analgesic. Cloves are used as well as the essence obtained by steam distillation. Cloves are used to treat physical and intellectual asthenia, dyspepsia, gastric fermentation, flatulence, diarrhea, intestinal parasites, pulmonary conditions (tuberculosis), dental neuralgia and impotence. It is also used to prepare for childbirth and to prevent infectious diseases. For all this you can take 2 to 4 drops of Clove essence 3 times a day in honey or in alcoholic solution. You can also very simply use Cloves regularly in daily cooking [14].

It is used during gastric and intestinal cramps accompanied by gas. In toothaches and oral infections (canker sores, ulceration), cloves are chewed or applied as a powder poultice to the cheek. The clove is also used, in decoction in milk or sugar water, against menstrual pain, intestinal ailments and diarrhea. Associated with other plants, it is part of the composition of creams and oleates intended for hair care. Externally, macerated in rose water or lemon juice and applied as compresses to the forehead and temples, cloves are used to soothe headaches [9].

***Plantago albicans* L.** (Plantain) **PLANTAGINACEAE**

Softener, astringent, emollient, diuretic and laxative. Associate with the root of colocynth to make poultices in the care of wounds. Against diarrhea.

***Plantago ovata* Forsk.** (Tamret lagrab; Plantain) **PLANTAGINACEAE**

Plant used against gastro-duodenal ulcers and against diarrhea [6]. The leaves, in hydrolat, associated with rose water, are used to protect the skin of the face [8].

***Plantago psillium* L.** (Assluj; Psyllium) **PLANTAGINACEAE**

Flea grass. The black seeds, in the shape of chips, soaked beforehand in milk overnight, are administered in all kinds of dysentery, gastro-uodenal ulcers, diarrhea [6].

***Hordeum vulgare* L.** (Chaair; Barley) **POACEAE**
Digestive, depurative, diuretic, anti-diarrheal, carminative. Soup prepared from barley (Balboula) is often recommended for fractured patients and diabetics. Roasted seeds are used as a carminative. Barley water is used as a gargle against throat ailments. It is also administered to children, in gastrointestinal diseases, and to adults in vesico-urinary irritations. Barley porridge is prescribed to breastfeeding women as it increases lactation [9].

***Cytinus hypocistis* L.** (Tertat; cytinet) **RAFFLESIACEAE**
The plant is used in the treatment of diarrhea [6].

***Delphinium staphysagria* L.** (hab-bet ras; staphysaigre dolphinelle) **RANUNCULACEAE**
The seeds, pulverized and combined with henna, are used as a poultice in hair care. The leaves, in decoction, are recommended against diarrhea and to inhibit milk production in women at the time of weaning. In high doses, the seeds are toxic [10,11].

***Ranunculus bullatus* L.** (wden the halluf; buttercup) **RANUNCULACEAE**
The roots, in decoction, are used against painful menstruation, stomach aches and to promote childbirth. The leaves are used as an infusion against diarrhea and renal lithiasis. The plant is irritating to the skin and mucous membranes. Ingested, it can cause stomatitis, burns and ulcerations[6].

***Reseda luteola* L.** (Al-lirún; Reseda dyers, sapling) **RESEDACAEAE**
A leaf infusion is used against diarrhea, colic and digestive poisoning caused by ingestion of gris-gris (tawkal) [6].

***Agrimonia Eupatoria* L.** (Terfaq; Agrimony) **ROSACEAE**
Mainly leaves and flowers are used. Internally, Agrimony is used to treat diarrhea, dysentery, hemoptysis, renal colic, renal lithiasis, albuminuria, white discharge, diabetes, hepatism, obesity and asthma . For all this you can take tincture of Agrimony at the rate of 20 drops 2 times a day. Against urinary incontinence, white losses, diarrhoea, nephrolithiasis and glycosuria, you can take an infusion consisting of 30 to 50 g of Agrimony per liter of water. This infusion should be taken at the rate of one cup 3 times a day between meals [14].

***Crataegus oxyacantha* L.** (The Hawthorn) **ROSACEAE**
Hawthorn is used to treat palpitations, heart pain, angina pectoris, vascular spasms, tachycardia and other arrhythmias, and hypertension. It is also used to treat congestive flushes, insomnia and other inconveniences of menopause, atherosclerosis, neurovegetative dystonia disorders (anxiety, dizziness, ringing in the ears), but also diarrhea, dysentery, and urinary and gallstones. For all this you can take it in the form of an infusion of one teaspoon of Hawthorn per cup of boiling water, to be taken at the rate of 2 to 3 cups per day [14].

***Rosa canina* L. (**ward, eglantine) **ROSACEAE**
Dried and pulverized flower buds are used, combined with myrtle, clove and henna for hair treatment. The decoction of flower buds is recommended in case of intestinal worms[10]. The rose is endowed with astringent, laxative, antidiarrheal, anti-inflammatory and stimulating properties [19].

Conclusion

The ethnobotanical survey carried out on the basis of 188 questionnaires and the inventory of anti-diarrheal medicinal plants in the Ouanougha region are summarized in the form of a floristic list containing 41 species belonging to 20 botanical families and 35 genera. These families are essentially dominated by the Lamiaceae (8 species), the Anarcadiaceae, Fabaceae, Myrtaceae, Plantaginaceae and Rosaceae (3 species); eight families containing two species and the other families containing one species.

The leaves are the most used organ. The methods of preparation most frequently employed for the majority of remedies are decoction and infusion.
We speak of diarrhea if the stools are more liquid and more frequent than usual (more than 3 loose or liquid stools per day). Other signs may be associated such as nausea, vomiting, abdominal pain or even fever. The main danger of diarrhea is dehydration. The majority of short-term diarrhea is due to infection by viruses (Rotavirus, Norovirus, Adenovirus), also called “seasonal epidemic gastroenteritis”.

It can be of bacterial origin by consumption of infected food (it will be commonly called "food poisoning") or can be due to parasites (unhygienic sanitary facilities). What to do in case of temporary diarrhea: during diarrhea, the body loses water and mineral salts. You must therefore compensate for these losses by drinking a lot of sweet and salty drinks (water, sodas, vegetable broths, etc.).

For your diet, choose foods that are easy to digest such as rice, cooked carrots… And avoid raw fruits and vegetables, frozen drinks and foods, spicy dishes.

Simple dietary rules are enough for the symptoms of diarrhea to disappear spontaneously within a few days. If your infant/child has diarrhea: give him oral rehydration solution (ORS) several times a day. Regularly offer your child to eat, and thus alternate ORS and food. Monitor him by regularly taking his temperature, his weight and noting the number of stools, the quantities drunk and his temperature. Attention the state of health of the young child can worsen in a few hours, especially if he is less than 6 months old. Remember that to prevent the onset of infectious diarrhea, have it on your hands several times a day.

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Fig. 2. *General view of the Ouanougha landscape (Top photo: Olive grove fields, bottom photo: Green oak grove) Photos: K. Rebbas*

EDIBLE COATING FOR FUNCTIONALITY IMPROVEMENT OF MINIMALLY PROCESSED ORGANIC APPLES

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Abstract: *Consumer interest in purchasing safe, nutritious, minimally processed, and healthy foods has led to increased consumption of various fruits and vegetables. In general, fruit quality depends on nutritional, microbiological and organoleptic properties, all of which are exposed to dynamic changes during harvesting, minimally processing, storage and marketing. These changes occur mainly due to the interactions between the fruit and the environment or the migration between the different internal components, which can lead to the loss of moisture and some volatile compounds. Therefore, an emerging need for quality preservation of fruits arise in the last years; the technique of edible coatings being a good alternative to control some of these factors, involving thin layers of edible materials formed directly on the surface of foods that can be consumed as part of the whole product. The purpose of the present study was to develop an edible coating based on pectin, with the addition of a functional organic seabuckthorn extract obtained by ultrasound assisted extraction, to improve organic apple cubes quality. The results of this study showed that the developed edible coating improved apple functionality, increasing the antioxidant activity and polyphenolic content of the coated apples.*

Keywords: *edible coating, organic, functional, ultrasound assisted extraction, pectin.*

1. Introduction

Fresh fruit and vegetables consumption is well known of having beneficial effects on human health [1], especially due to their nutritional value. Nowadays, consumers are more and more interested in fresh and ready to eat products, fact that led to an increased production of minimally processed fruits and vegetables. 'Minimal processing' refers to physical changes made to produce initial state, such as peeling, washing and/or cutting, and the resulted product could be directly eaten, without any other preparation [2]. However, fresh fruits are known to be perishable products with a very short shelf life, the main cause of postharvest degradation being water loss [3]. A great amount of waste materials is generated yearly along the food production or supply chains [4], reaching to 1.3 billion tons per year in Europe in terms of organic waste linked to human activities [5]. Therefore, the valorization of natural origin waste in terms of circular economy model represents a great prospect which can be applied in different sectors, like food industry, agronomy, forestry, or marine domain [6].

Ultrasound assisted extraction is described by various authors as a green technology which is easy to operate and highly effective [7-8]. It is based on cavitation effect which leads to disruption of cell wall, allowing the rapid diffusion and release of bioactive compounds through cell membranes into the solvent [5, 7, 9]. This extraction method presents advantages compared to conventional methods, due to short extraction time, low quantity of extraction solvent and higher extraction yield [8, 10].

Edible coatings can form a semi-permeable barrier to gasses and can be used as carriers for functional or active food additives which can lead to the improvement of product quality and shelf-life of fresh fruit and vegetables [1-2, 11], having comparable properties with the ones characterizing modified atmosphere packaging [12]. They can be obtained by using natural renewable resources, contributing this way to waste reduction and environmental protection [13]. The application of edible coatings on fresh fruits can be performed by various methods, such as spraying, panning, or dipping [14], preventing water loss, gas exchange, reducing respiration

and transpiration rate and other oxidative reactions [2-3, 15].

Pectin is a great component for edible coatings development, being non-toxic, biodegradable, readily available and low cost [16]. It is a high molecular weight water soluble polysaccharide composed of mainly (1→4) bonded α-D-galacturonic acid [2], being characterized by hydrophobic groups presence, formed of acetyl, methyl ester, and protein [1]. Pectin can be extracted at an industrial scale from various by-products resulted from fruit processing, such as citrus peel and apple pomace [2], banana peel, sugar beet pulp, mango peel or watermelon seeds [17].

2. Materials

Within this study, experiments for obtaining edible coated apples cubes with improved functionality were performed. Organic seabuckthorn - SB (pomace) from the organic Mara variety (Fig. 1) and organic apples from the Dalinette variety were used in the experiments.

Fig. 1. *Dried seabuckthorn pomace from Mara variety used in the experiments*

3. Methods

US assisted extraction

The extraction of powder samples was conducted by US assisted extraction using a Biobase UC-40A system, the extract samples being US for 15 min at 40°C.

Weight loss (%)

Weight loss was determined by calculating the difference between the weight of the sample before storage and the moment of analysis, and the results were expressed as a percentage (%).

Water activity (a_w)

Water activity of tested samples was determined using NOVASINA equipment. Briefly, the sample was introduced into specific recipients of the equipment and the value of a_w was read when stable at 25°C.

Dry matter content (%)

The determination of the total dry matter (DM) was performed by weighing 5 g of sample, which was further subjected to drying at 105°C using the RADWAG MAC 50 thermobalance. The results were expressed as a percentage (%).

Ascorbic acid content (% DM)

The content of ascorbic acid was determined by extracting 10 g of sample in 100 ml of 2% oxalic acid solution. The extract was filtered and 2 ml from the extract solution, 1 ml oxalic acid 2%, 5 ml buffer solution, 2 ml indophenol (2, 6-Dichlorophenol Indophenol) and 20 ml xylene, were placed in a centrifuge tube and centrifuged for 20 min at 5°C and 9000 rpm. The absorbance of the samples was measured 500 nm and the results were expressed as mg ascorbic acid / 100g DM.

Antioxidant activity using DPPH method

The effect of antioxidant activity on 1,1-dipheny l-2- picrylhydrazyl (DPPH) was estimated according to the procedure described by Villaño et al. (2007) [18], with some modification presented further. Briefly, in 50 ml ethanol (75%) there were macerated 10 g of sample in the dark for 48 h in the dark, at room temperature. The obtained extract was mixed with DPPH ethanolic solution and homogenized. After incubation at room temperature in the dark for 30 minutes, the absorbance of the samples was measured at 515. Results were expressed as quercetin equivalents (QE) per 100g DM.

Total polyphenolic content

Total content of polyphenols (TP) was determined using the Folin-Ciocalteu method previously described by Popa et al. (2019) [19]. Sample absorbance was measured at 765 nm. Total polyphenol concentration was expressed as mg/L Gallic acid equivalents (GAE) per 100g DM.

Color determination

Color assessment was conducted at room temperature using a HunterLab colorimeter, Miniscan XE Plus. Fruit colour was described using L*, a*, and b* CIE coordinates. L* axis represents the lightness with values ranging from 0 (black) to 100 (white), the a* axis is red-green with negative values for green and positive values for red, and b* axis is blue-yellow with negative values for blue and positive values for yellow [20].

4. Results

Extract preparation and characterization

First, the optimization of SB extraction was conducted. Therefore, extracts were obtained by mixing 5g SB pomace or mild grinded SB pomace with 30 ml of distilled water and US at 40°C. The obtained extracts were analyzed, and their antioxidant activity and polyphenolic content were determined.

Water extracts of SB were obtained as follows:

- 5g dried SB pomace in 30 ml of distilled water, US for 15 min at 40°C
- 5g dried SB pomace in 30 ml of distilled water, US for 30 min at 40°C
- 5g mild grinded SB pomace in 30 ml of distilled water, US for 15 min at 40°C
- 5g mild grinded SB pomace in 30 ml of distilled water, US for 30 min at 40°C

The obtained extracts were filtered, and the obtained filtrate was further characterized. The results are presented in Table 1.

Table 1. *Characteristics of the obtained extracts (antioxidant activity and polyphenolic content)*

Sample	Antioxidant activity (QE/100 ml)	Total polyphenolic content (mg GAE/100 ml)
dried SB pomace extract, US 15 min	1124.82 ± 2.43	573.8 ± 11.31
dried SB pomace extract, US 30 min	1124.82 ± 2.43	556.3 ± 6.36
mild grinded SB pomace extract, US 15 min	1111.38 ± 11.60	713.3 ± 98.28
mild grinded SB pomace extract, US 30 min	994.45 ± 151.40	1081.3 ± 116.67

Analyzing the obtained results, it was observed that there are no significant differences between the extracts when it comes to the US time, so the experiments were further conducted with the dried SB pomace extract, US for 15 min at 40°C.

Edible coating preparation

The edible coating (Fig. 2) was obtained using 3g/100 ml pectin, 1ml/100ml glycerol and 99 ml of dried SB pomace water extract (which replaced distilled water in the coating formulation). Pectin was first solubilized in the SB water extract under heating, and after the mixture cooled down, glycerol was added.

Fig. 2. *Edible coating solution*

Apple cubes were further cut with the side of 1 cm and immersed into the coating solution for 2 min and then removed and kept at room temperature for 45 min and afterwards with ventilation at room temperature for another 45 min, to obtain a dry coating (Coated sample). Fresh apple cubes were used as Control sample. The obtained samples were then stored in refrigeration conditions (at 4°C) and further analyzed during a period of 4 days. The obtained results are further presented.

Weight loss (%)

Samples weight loss (%) values during refrigerated storage are presented in Table 2. It was observed that for the coated sample, lower values were registered compared to control sample, which means that the applied coating acted as a barrier to water loss for the apple samples.

Table 2. *Weight loss values during refrigerated storage*

Sample	Day 0	Day 1	Day 3	Day 4
Control sample	0%	2.61%	3.39%	3.52%
Coated sample	0%	2.37%	3.13%	1.97%

Water activity (a_w)

Water activity (a_w) values registered for the tested samples are presented in Table 3. It was

observed that a_w values slightly increased during storage for both Coated and Control samples. However, lower values were obtained for Coated samples, suggesting that the coating could slow down the growth of microorganisms in the apple sample.

Table 3. *Water activity values for the tested samples during refrigerated storage*

Sample	Day 0	Day 1	Day 3	Day 4
Control sample	0.978 ± 0.001	0.982 ± 0.001	0.981 ± 0.002	0.985 ± 0.000
Coated sample	0.973 ± 0.002	0.976 ± 0.000	0.977 ± 0.000	0.981 ± 0.000

Dry matter (%)

Dry matter (%) values are presented in Table 4. Higher values during storage were obtained for the coated sample compared to control, but not significant higher. The obtained results are in accordance with the values obtained for sample weight loss (%).

Table 4. *Dry matter values for the tested samples*

Sample	Day 0	Day 1	Day 3	Day 4
Control sample	15.980 ± 0.07	14.985 ± 0.13	15.382 ± 0.54	15.571 ± 0.12
Coated sample	18.362 ± 4.35	15.933 ± 0.11	15.956 ± 0.01	15.747 ± 0.00

Ascorbic acid content

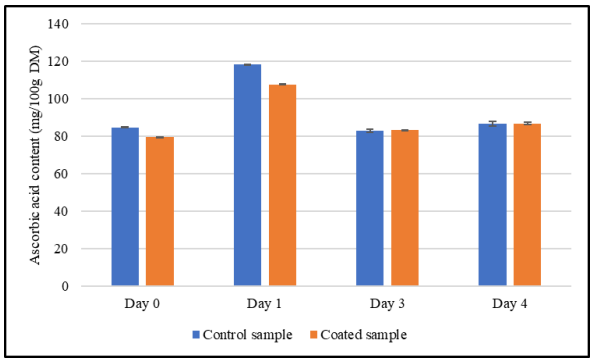

Fig. 3. *Ascorbic acid content during storage, for the obtained samples*

Ascorbic acid content (Fig. 3) was similar for both control and coated sample. The variation occurred between the moment of analysis could be due to the non-uniformity of the apples used within the study. Overall, the edible coating helped preserve the ascorbic acid content of the apples during storage.

Antioxidant activity

The antioxidant activity of the analyzed samples was higher during storage for the coated samples (Fig. 4). Therefore, at the end of the storage period Control sample presented an antioxidant activity of 1866.37 QE/100g DM and Coated sample presented a value of 2015.40 QE/100g DM.

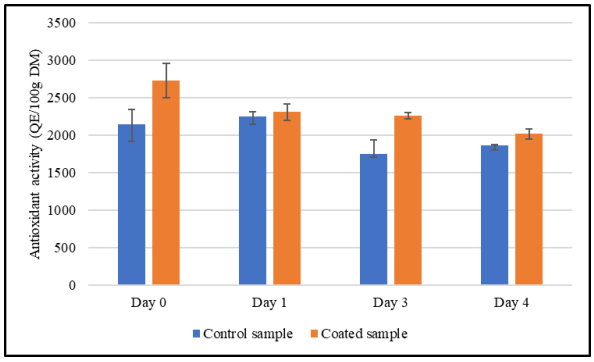

Fig. 4. *Antioxidant activity during storage, for the obtained samples*

Total polyphenolic content

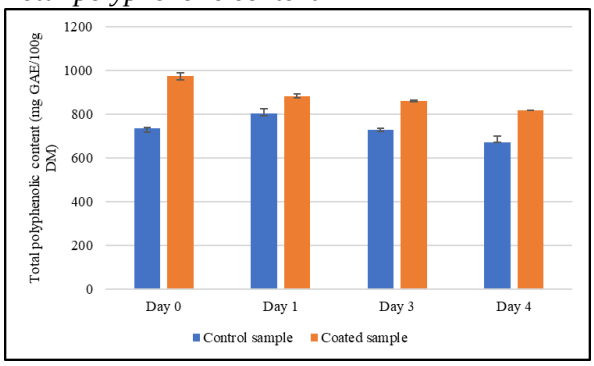

Fig. 5. *Total polyphenolic content during storage, for the obtained samples*

It was observed (Fig. 5) that in case of the total polyphenolic content higher values were obtained for coated sample, compared to control sample. However, during storage, the values decreased for both samples from 734.01 (Day 1) to 673.04

(Day 4) for Control sample and from 973.75 (Day 1) to 817.90 (Day 4) for Coated sample.

Color determination

The lightness (L*) of the analysed samples (Table 5) decreased during the storage period for both analysed samples. The differences between Control sample and Coated sample were not significant, suggesting that the coating does not modify the colour of the apple cubes.

Table 5. *Lightness (L*) values for the analysed samples*

Sample	Day 0	Day 1	Day 3	Day 4
Control sample	78.566 ± 0.41	68.121 ± 0.87	65.434 ± 0.69	65.373 ± 1.00
Coated sample	73.281 ± 0.53	68.754 ± 1.93	71.746 ± 0.35	68.157 ± 0.80

Table 6. *Redness (a*) values for the developed samples*

Sample	Day 0	Day 1	Day 3	Day 4
Control sample	-1.792 ± 0.11	5.596 ± 0.71	5.409 ± 0.19	5.453 ± 0.29
Coated sample	1.536 ± 0.09	3.936 ± 0.42	3.542 ± 0.20	5.751 ± 0.21

Table 7. *Yellowness (b*) values for the developed samples*

Sample	Day 0	Day 1	Day 3	Day 4
Control sample	31.411 ± 0.23	36.191 ± 1.78	38.181 ± 1.01	37.056 ± 1.01
Coated sample	36.698 ± 0.69	38.229 ± 1.30	35.378 ± 0.53	36.582 ± 0.30

The redness (a*) values (Table 6) increased during storage, suggesting that the colour of the samples changed by the installation of browning process. The yellowness (b*) of the samples (Table 7) varied during storage, but the differences between the two analysed samples were not significant. The aspect of the analysed samples during storage is presented in Fig. 6.

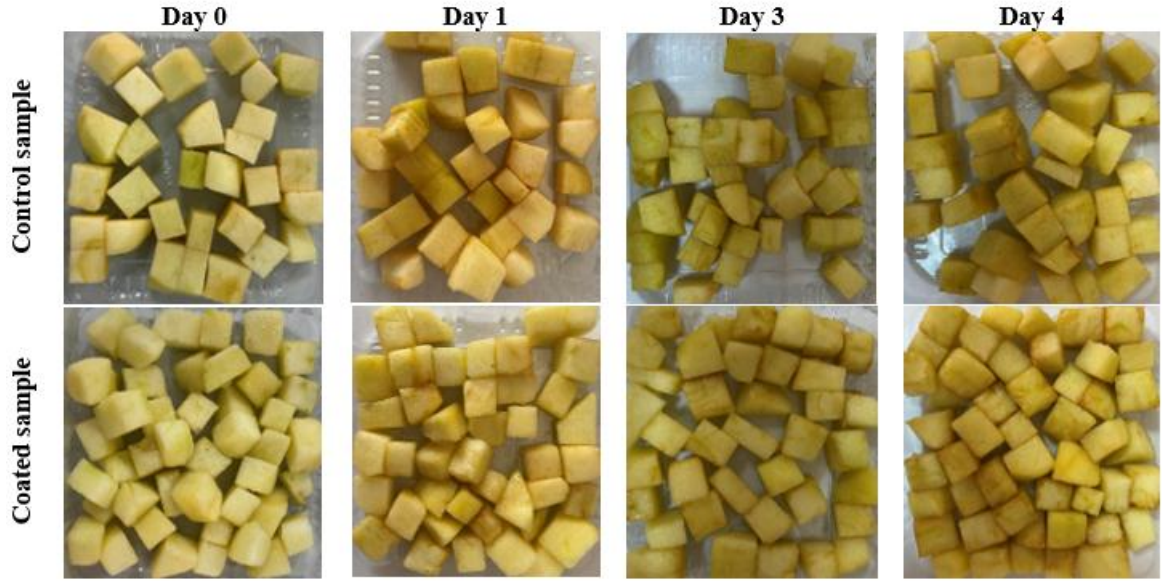

Fig. 6. Samples aspect during the storage period

5. Conclusions

Functional coatings represent a good alternative to packaging for minimally processed fruit preservation and quality maintaining. They also can be used as carriers for different functional ingredients that could lead to an improved functionality of food products. The results of this study showed that the developed edible coating improved apple functionality, increasing the antioxidant activity and polyphenolic content of the coated apples. Furthermore, the aspect of the

coated samples was maintained during storage at 4°C for 4 days, the browning process being more intense for Control sample, compared to coated sample.

Acknowledgements

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FORTIFIED JELLYS WITH VITAMIN C - COMPOSITION AND SENSORY ANALYSIS

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Abstract: *Experiments were carried out with the aim of determination of the suitability of fruits of rose hips for processing of jelly. Jellies with rosehip extract represent an innovative product that stands out for its special sensory and nutritional characteristics, the rosehip extract successfully complementing the functional valences of the jellies. In the sensory analysis, three variants of jellies with different rosehip extracts were tested. According to the sensory analysis, the most appreciated version was the one with berry syrup and rosehip extract.*

Keywords: *rosehip; bioactive compounds; fortification;*

1. Introduction

Gelatin desserts were popular, if not standard, in American kitchens—those proto-futuristic dishes of canned cocktail fruits encased in artificially flavored, with different shapes and colors [1]. Several studies were made on jelly fortification with different bio-compounds, in order to help consumer to increase their low intake of minerals or vitamins [2].

Jellies are products with a gelatinous, translucent consistency, with a pleasant sweet-sour taste specific to the flavoring and additive used, obtained from a sugar-glucose syrup into which a substance with gelling properties has been introduced [3].

The objective of this work is to expand the range of functional gelled products, obtain and test in the gastronomy laboratory jellies with different additions of rosehip extracts, because following the pandemic context the consumption of vitamin C has increased considerably, and this product is designed to meet the needs to all categories of consumers, being an important source of vitamins, being enriched with antioxidants and biologically active compounds.

The jellies with *Rosa Canina* extract are an innovative product, and of a higher quality than those currently available, knowing that innovation is one of the most effective tools for increasing market share, representing the engine of progress in this field.

The addition of rosehip extract to pectin jellies results in a product with a high content of vitamin C, a valuable essential compound with an important role in protecting the body, against infections and improving the immune system. It is a "fortified" jelly intended for all age groups and for everyone's taste, contributing to the supplementation of water-soluble vitamins in the diet, which are always necessary in high doses, such as L ascorbic acid.

This idea of creating a new product aims at obtaining innovative features with a positive functional impact on the health of consumers, correcting the chemical composition of jellies currently on the market while preserving traditional consumer properties, bringing to the market a new concept and realization of biotechnologies with high productivity.

Igual et al. studied the use of Rosehip formulated purees with encapsulating agents as interesting food ingredient that are rich in fiber and minerals that could be used in the food industry in order to obtain different functional foods [4].

Fig. 1. *Jellies with rosehip fruit extract*

Rosehip, with the scientific name *Rosa canina* L. is the head of the series of the great family of *Rosaceae*, even the scientific name also comes from a medical use, but completely unexpected "*canina*" meaning "dog" in Latin, this because in Antiquity considered to be an effective remedy against turbidity [5]. The chemical composition convincingly explains the main use of rose hips as a raw material in obtaining jellies, this being an excellent tonic - vitaminizer, recommended especially for convalescents and children, in cases of avitaminosis [5].

Thus, they contain 4-16 times more vitamin C, for example, than citrus fruits, real "standards" in this field, and compared to other indigenous fruits, the ratio is higher, surpassing 80-100 times cherries and sour cherries, by approx. 120 times peaches and apricots and almost 200 times apples, pears, plums and melons. It should be noted that the mountain rosehip fruits have a much higher content of vitamin C (8 - 10 g %), surpassing the content of the field fruits by about 10 times. In terms of vitamin A, rose hips also have no equal, exceeding 2 times apricots (considered to be the richest in this vitamin), 10 times blueberries (also rich) and more than 20 times apples [5].

One of the most impressive benefits of rose hips is the high concentration of vitamin C. Having a very important role in the immune system, including stimulating the production of white blood cells called lymphocytes, which protect the body against infections; it also contributes to maintaining the protective barrier of the skin against external pathogens [6].

Fig. 2. *Rosa Canina*

2. Materials and methods

For the preparation of jellies on a laboratory scale, recipes were chosen that use pectin as a gelling agent, the main stages in the process of obtaining the experimental variants in the laboratory phase were dissolving, boiling and mixing the raw materials and ingredients in different proportions, pouring and cooling and taking out of shapes) [7].

To achieve the objectives of the experimental research, the following products were prepared: jellies with rosehip syrup, jellies with rosehip paste + rosehip syrup, jellies with berry syrup + rosehip sap extract.

For each of the 3 jelly samples, the sensory analysis was carried out, and for the extracts used, the content of vitamin C (Palladin method), acidity (titration with NaOH 0.1N), pH and dry matter was determined (ABBE refractometer) [8-10].

3. Results

All 3 jelly samples were analyzed in terms of vitamin C content, % acidity (% citric acid), Ph, and soluble dry matter (^{o}Bx).

3.1. Determination of C vitamin content

Analysis of L-ascorbic acid content was performed using the supernatant and an enzymatic method (L-ascorbic acid assay kit, Megazyme Ltd., Sigma Aldrich, USA, product code MAK074) following the manufacturer's instructions. Absorbance was measured at 570 nm.

3.2. Ph determination

The pH of the rosehip extracts was determined using a portable pH meter.

3.3. Acidity determination

Acidity was determined using the titration method. The acidity of the sample to be analyzed was titrated with a 0.1N sodium hydroxide solution, in the presence of phenol red or phenolphthalein as an indicator.

3.4. Soluble dry matter determination (°Brix)

Using the ABBE refractometer equipped with a graduated scale in refractive index values with a precision of 0.0002, the refractive index at the ambient temperature of 20°C and the soluble dry matter content, expressed in g, were determined.

The results of psysico-chemical analysis are presented in table 1.

Table 1. *Physico-chemical analysis results of the extracts used as an ingredient for jellies*

Sample type	Vitamin C content (mg/100g)	Acidity (% citric acid)	pH	Soluble dry matter (^{o}Bx)
Rosehip paste	85,26	0,36	5,2	63,9
Aqueous rosehip extract	475,35	1,47	3,8	24,3
Rose hip shoots extract	628,59	0,82	4,9	11,7

3.1. Sensory analysis of jellies

Sensory evaluation of food is an important aspect for the development and marketing of new products, providing a good knowledge of both consumer behavior and means of quality assurance. The sensory analysis of jellies with rosehip fruit extracts was carried out at the European Researchers' Night event, within *Transilvania* University, Brașov.

To carry out the sensory analysis of the three types of jellies with rosehip fruit extracts, 5 teams consisting of 8 tasters were selected. Under optimal environmental conditions, the tasters were served the three randomly coded samples S, P+S, S+E, representing the type of jelly. 40 evaluators participated in the sensory analysis.

An evaluation scale with values between 0 and 4 points was established for the evaluation of the organoleptic characteristics.

- External appearance and in section;
- Consistency;
- Color;
- Smell;
- Taste.

The tasters received the analysis report for the three types of jellies, analyzing the sensory samples and scoring them according to the attributes in table 2, and following the guide presented in table 3.

Table 2. *Sensory analysis bulletin of jellies with rosehip fruit extracts*

Sensory characteristics	Individual score (0-4)			Remarks
	S	P+S	S+E	
External appearance and in section				
Consistency				
Color				
Smell				
Taste				

Table 3. *Scoring guide for evaluating the sensory characteristics of jellies*

The experimental samples	External appearance and in section	Smell and taste	Color	Consistency
Jellies with fruit syrup + rose hip shoots extract	Well-defined shape, transparent mass, free of suspended particles, air bubbles and foam.	Pleasant, well pronounced, characteristic of rosehip extract from which the jelly is made. It does not present foreign odors, of altered product.	Uniform throughout the mass of the product, specific to the light, homogeneous hibiscus sabdariffa dye.	Homogeneous, gelled mass that retains its shape on a horizontal surface after unpacking, having a clear delimiting surface when cut with a knife. Saccharification, the presence of a sticky, syrupy layer and the formation of a hard crust made of sugar crystals are not allowed.
Jellies with rose hip syrup	Well-defined shape, transparent mass, free of suspended particles, air bubbles and foam.	Pleasant, well pronounced, characteristic of rosehip extract from which the jelly is made. It does not present foreign odors, of altered product.	Uniform throughout the whole mass of the product, specific to rosehip syrup, yellow-orange, light, homogeneous.	
Jellies with rosehip paste+syrup	Well-defined shape, transparent mass, free of suspended particles, air bubbles and foam.	Pleasant, well pronounced, characteristic of rosehip extract from which the jelly is made. It does not present foreign odors, of altered product.	Uniform throughout the mass of the product, specific to rosehip paste and syrup, dark brown, homogeneous.	

3.2. Results interpretation

To evaluate the sensory quality, the scoring scale method was used [12, 13], from 0...4 points, established in the standards for the sensory analysis of jellies. The tasters completed the analysis report that accompanied the samples to be analyzed and examined the sensory characteristics in the order indicated by the team leader. The taster team leader recorded the individual tasters' scores for each characteristic in a central sheet and checked whether or not a taster's score for a characteristic deviated by more than one point from the group mean score.

The calculation of the total average score is calculated by summing the values of the scores awarded from all the organoleptic characteristics, the results being recorded in the centralizing table 4.

Table 4. *Centralized scores for the studied samples*

Sample	T.N. of scoring	Qualification given
Jellies with rose hip syrup	630	Satisfăcătoare
Jellies with rosehip paste+syrup	698	Foarte bun
Jellies with fruit syrup + rose hip shoots extract	663	Bun

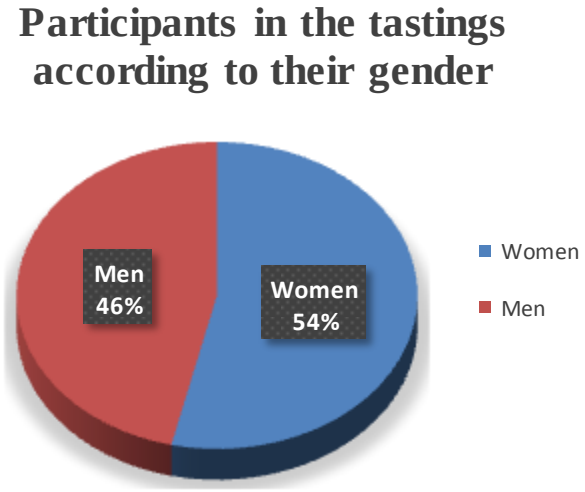

Fig. 3. *Participants in the tasting according to their gender*

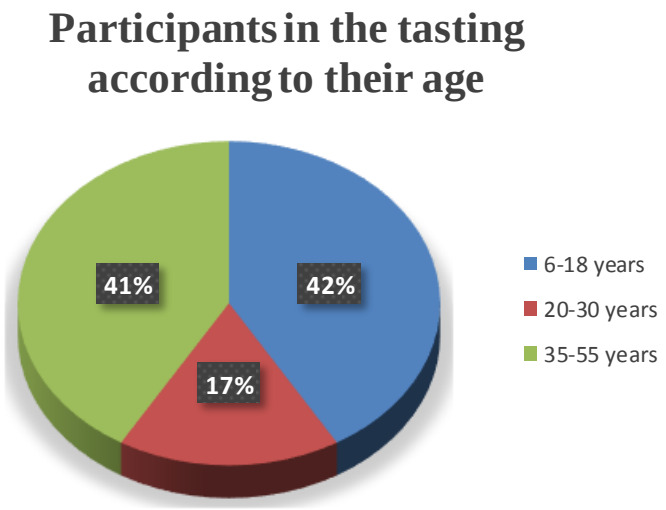

Fig. 4. *Participants in the tasting according to their age*

4. Conclusions

Jellies with rosehip extract represent an innovative product that stands out for its special sensory and nutritional characteristics, the rosehip extract successfully complementing the functional valences of the jellies. In the sensory analysis, three variants of jellies with different rosehip extracts were tested. The types of rosehip extracts having a decisive role in defining the organoleptic properties of the jelly variants. According to the sensory analysis, the most appreciated version was the one with berry syrup and rosehip extract dosed in the amount of 60g syrup and 60g rosehip extract per 300g jellies.

The classification of the jellies was based on the notes given by the tasters, but also according to the observations noted by them. The very good rating was given due to the fact that the jellies had the color, aroma and intense taste of rosehip, suitable texture, as expected. The good rating was given due to the attractive color and smell, but the consistency being slightly soft and with too intense a taste of rose hip extract led to the awarding of a score lower than the maximum.

The satisfactory rating was given due to the fact that the S sample was weakly aromatic and slightly medicated, which attracted a low score.

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