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An Avocado Relative: Beilschmiedia anay (Blake) Kosterm. A Fruit Source

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Summary

Beilschmiedia anay (Blake) Kosterm. fruits vary in size, pulp:seed relationship, and taste. Preliminary analyses of the pulp and seed confirm a suspected high concentration of fatty substances (34.57% d. wt.) in the pulp and, what is surprising, of protein (8.0% d. wt). The concentration of both compounds is higher than in avocado pulp. The color of the pulp and dishes prepared with it (guacamole, cream soup, ice cream) were good and very stable, without browning and without the bitter taste which is typical for some avocado preparations. The search for escalan types and the formulation of germplasm collection will continue. It would be worthwhile to include this species on the list of fruits with commercial future for industrial or home use.

Introduction

Mexico is rich in fruit genetic resources. Many of the native species are endemic. The variability of some of the species evaluated is very high, which permits the selection of a desired type relatively easily. This locates Mexico's resources in an exceptional position according to the present state of botanical inventory[5]. One of the unexploited genuses is Beilschmiedia Nees[4,5,8,11,12]. The genus is represented by more than 300 tropical and subtropical species in Africa, Australia, Brazil, Colombia, Costa Rica, Guatemala, Honduras, Indonesia, Java, Madagascar, Mexico, New Zealand[1,2,3,7,12]. The plant size varies from large trees to shrubs[3,7,10,12]. This genus, rich in species, remains obscure for its fruit values or as a source of rootstocks. The only species appreciated locally (Veracruz and Sierra Norte de Puebla, Mexico) for its fruits is B. anay (Blake) Kosterm. known under the local names 'escalan' or 'anay'. Its fruits are very similar in shape, size, and taste to avocado and vary little or vary widely in size and/or in color of the skin and taste[1,4,8,11,12]. This paper summarizes the findings on some of its fruit characters as well as of the tree components.

Materials and Methods

The species was reported to be present in the area of Totula-Sierra Norte de Puebla, Estado de Puebla, Mexico by Leszczyñska-Borys *et al.,* (1992). Fruits were collected in November-December 1992, which is its harvesting time in this locality. The fruits were

"ready to harvest with firm pulp," a state of maturity considered by the local population to be ready to harvest. The fruit harvested November 21, 1992, were ready to eat November 26-27 and a palatability test was conducted on November 27. The number of available sound fruits was limited by the presence of damage from pests (mining larvae or seed-attacking insects) or fungi. It was not possible to identify the causal agents. The data on locality climate and other data are given by Leszczyñska-Borys (1992). Seeds from the types were placed in the germplasm collection of Persea and its relatives in Cictamex, Coatepec Harinas, Estado de Mexico. Also, some of the seeds were clonally propagated by tissue culture with the objective of establishing an experimental plot for further evaluation. The weight determinations were made with balances of two different precision levels, as are reflected in the data. The first sample of Negro Type was evaluated directly upon harvest, and the second after one month of storage in a home refrigerator (±5° C). The Verde Type was evaluated directly after obtaining the fruits. Although the data are preliminary, we thought them worthy of report. The project's final aim is to select types with the best horticultural characteristics of fruit and tree components. Chemical analyses were made of ten fruits sampled after drying in 105° C (Ca, P in ash), according to A. O. A. C. methods[6].

Results and Discussion

The Beilschmiedia genus is represented in Mexico by B. americana (Mez.) Kosterm., B. anay (Blake) Kosterm., B. aff. hondurensis Kosterm., B. mexicana (Mez.) Kosterm., B. ovalis (Blake) Allen, B. péndula (Sw.) Benth., B. riparia Mir. (= B. mexicana (Mez.) Kosterm.), B. schiedeana, B. steyermarkii Allen, according to the specimens seen in herbariums of the Instituto de Ecología A. C., Xalapa, Ver. (XAL); Instituto de Ecologia, Centro Regional del Bajío, Pátzcuaro, Michoacan (IEB), Colegio de Postgraduados, Centro de Botánica, Chapingo, México (Chapa).

B. anay was found in the wild in coffee plantations as shading plants, and in home gardens in the States of Veracruz, Oaxaca, and Chiapas. The extent of its use as a fruit source by the local population is unknown. The information gathered indicates that, at least in Puebla and Veracruz, where some frees have been found, fruits of 'escalan' are consumed directly or are used in preparing local dishes.

Fruit Characteristics.

Three samples were obtained. The fruit is obovate in shape and rather small. The fruit shape and the pulp-to-seed ratio are illustrated in **Figures 1 and** 2. Data on average weight and lineal dimensions are given in **Tables 1 and** 2. One type (Totutla Negro) has a dark epidermis; the other (Totutla Verde), a green epidermis. Totutla Negro has a very thin skin, which is an obstacle to pulp separation if one desires to remove it. Normally, the pulp of Totutla Negro is eaten with its epidermis. The epidermis of Totutla Verde is relatively thick (0.4 mm, approximately). Both types have smooth, glossy skins and are handsome fruits. Both produce fruit of similar size. The pulp mass (pulp + epidermis) in relation to the entire fruit is favorable. This suggests that the trees in the past were selected for the pulp stratum. The base of the fruit is flattened or depressed, and its

apex is slightly depressed, flattened, or rounded, the pedicel position varies from a central to an asymmetric one. The size of the fruit is similar to the data reported by Pennington and Sarukhan (1968), although smaller than cited by Allen (1945).

The epidermis of the Totutla Negro, at fruit maturity, is brittle, while that of the Totutla Verde is pliable. Its respective texture is membranous and leathery, fibrous. The pulp color is light-green to green, changing near the seed to light-green or light-yellow. The pulp texture, as judged by a group of 18-20 persons, varies from watery, creamy to granular. Its taste was judged from a sweet-acidic, avocado-like to poor. No bitterness was found in either type. The Negro type was low to moderately spicy in taste, while the Verde type was very spicy and highly aromatic. The pulp of both types was fiber free. No pulp blackening or browning was found in fresh fruit exposed to air for more than five hours. The fruits of Totutla Negro exposed for four weeks in a home refrigerator to 5°C in plastic bags, in overripe condition, showed pulp browning.

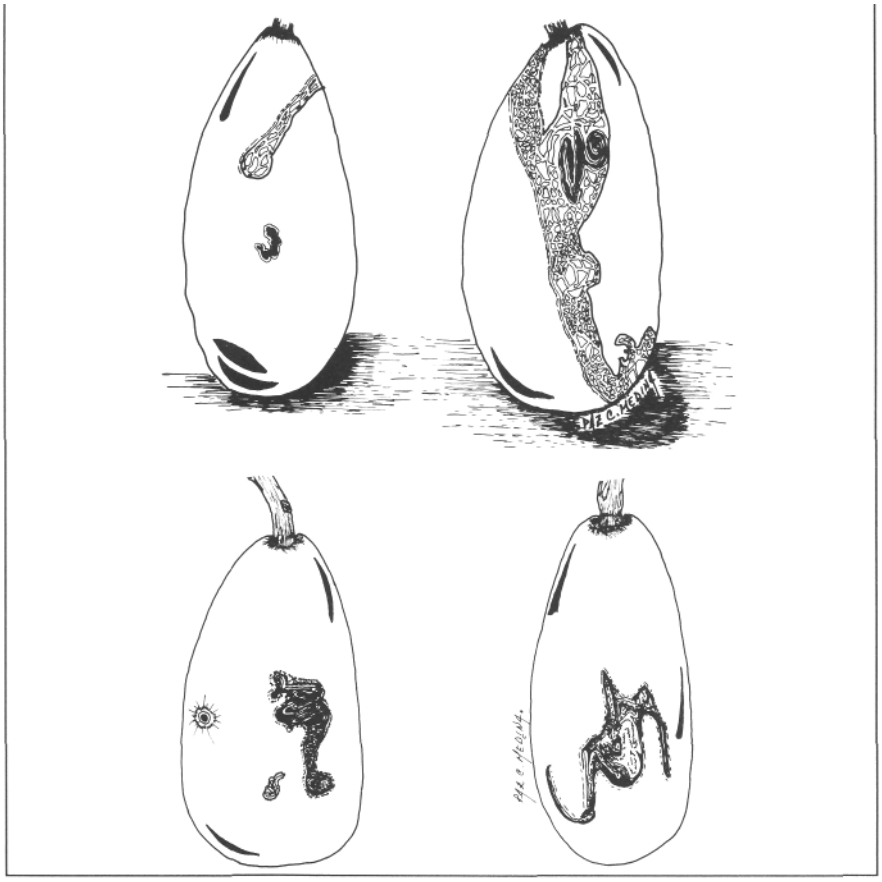

Fig. 1. *Forms of the fruit and the seed of B. anay (Blake) Kosterm. type Totutla Negro. Note the presence of symptoms of attack by mining insects and microbes of unknown origin.*

Table 1. Weight of fruit components.

	Fresh Weight (g)			
	Fruit	Seed	Pulp*	Seed Percent of Fruit
		Totutla Negro - Sample 1		
Mean	125.6	47.8	78.5	37.6
Minimum	85.0	35.0	50.0	31.0
Maximum	165.0	60.0	105.0	45.5
SDn	19.1	6.6	13.8	3.1
		Totutla Negro - Sample 2		
Mean	139.6	41.4	98.2	29.7
Minimum	100.3	27.9	69.7	26.0
Maximum	178.0	52.5	128.0	39.7
SDn	20.7	7.1	15.5	3.3
		Totutla Verde		
Mean	130.2	45.1	86.0	34.45
Minimum	97.4	37.5	59.9	28.35
Maximum	165.3	47.2	118.1	38.50
SDn	22.5	4.4	18.9	3.24

*Including the epidermis

Limited tests run at home to determine the feasibility of using the pulp (without the epidermis) resulted in the following opinions. The pulp can be used in salads and in making guacamole, soup (cream), and ice creams. The guacamole, cream, and ice cream from the Totutla Negro were delicious or acceptable; the ice cream was judged as delicious (greenish pistachio-like color; and very pleasant aroma, good taste, very fine general appearance). While making the cream, the temperature went out of control and it started to boil. This is generally not acceptable with avocado pulp as a base of cream soup because of possible browning and, especially, of liberation of a "bitter" taste. These results did not occur with the Negro Type, even though the cream was left to stand for two days with daily reheating. These characteristics distinguish the quality of escalan as compared to avocado fruits.

The ice cream made from Totutla Negro pulp was excellent. That made from the Totutla Verde, however, was marked by intense aroma and taste, though it was very pleasant when consumed in small amounts. Perhaps the pulp of Totutla Verde could serve as a source of aroma and color for the ice cream industry, and in the making of milk shakes, etc.

The ad hoc organized tests of acceptance involving university people (1820 persons) and at the family level (12 persons) also provided a comparison of knowledge of pulp classification in species or horticultural races of avocado. The individuals asked to classify the fruit identified the Negro Type as being in the classifications of avocado, chinini, tzi-tzi, pahua, or anay. The diversity of opinions suggests that for some part of the groups the Negro Type can serve as a substitute for or complement to avocado fruits. This itself is very promising for reasons mentioned above.

Another interesting feature of escalan fruit is its basic chemical composition (Table 3). The pulp of escalan is richer in protein and higher in oil than avocado fruit listed by Cictamex (1985) for a range of cultivars. The sweet taste of the pulp, which is not acceptable to many persons, may be related to the high concentration of digestible carbohydrates (N-free extracts). This taste component, as well as a perception of acidity noted by some persons while eating the pure pulp, was not mentioned by Allen (1945) or by Pennington and Sarukhan (1968). Allen (1945) cites an opinion about anay fruit quality as "of good flavor similar to that of an avocado, but not oily.

Table 2. Lineal dimensions of fruit component - Type Totutla Negro

	Length (cm)		Width (cm)				Pulp Depth (mm)	Length:Width Ratio	
	Fruit	Seed	Fruit	Seed				Fruit	Seed
				1	2	Mean			
Totutla Verde — Sample 1									
Mean	9.97	9.07	5.30	3.56	3.86	3.71	9.40	1.89	2.45
Minimum	9.30	8.50	4.40	2.90	3.20	3.10	8.50	1.69	2.21
Maximum	10.50	10.00	6.20	4.00	4.30	4.20	10.50	2.17	2.85
SDn	0.38	0.04	0.42	0.25	0.28	0.26	0.07	0.13	0.17
Totutla Verde									
Mean	9.68		5.13						
Minimum	8.20		4.10						
Maximum	10.98		5.86						
SDn	1.03		0.62						

Table 3. Chemical composition of main fruit components—Type Totutla Negro

		Pulp	Pulp + Epidermis	Seed
Dry matter (%)		17.17	17.67	30.40
H2O (%)		82.83	82.33	69.60
Ash (% d. wt.)		4.55	4.62	3.07
Protein (% d. wt.)		7.73	8.30	4.95
Ethyl ether extract (% d. wt.)		36.18	33.76	2.37
Crude fiber extract (% d. wt.)		21.36	16.38	5.61
Extract free of	N (% d. wt.)	30.18	36.94	84.00
	Ca (% ash)	0.61	0.47	0.36
	P (% ash)	0.30	0.30	0.23

Seed.

The elongated seeds (the mean ratio of seed length to width is 2.45, **Table** 2) are slightly asymmetric, as shown by the diametric measurements (0.30 cm of difference, **Table** 2). They are oblong or pyriform **(Figures** 2 **and** 3), pointed in their apical or basal ends. The seed covers presented one, or rarely two, fragile peaks at their basal ends at the time of seed extraction from the pulp **(Figure** 3). At the apical end the extension of pedicel tissue very frequently remains on the seed cover, forming a nail-like, woody cylinder. This drops easily upon extraction of the seed from the pulp, leaving an open hole in the apical part of the seed cover **(Figure 3).**

The seed cover is thick, leathery, and strongly attached to the cotyledons. Leaving the extracted seeds in the open for a few days facilitates the release of the thick cover from the cotyledons, though thinner covers may remain attached. The leathery cover has nicely designed lines of conducting tissues running along the seed, characterized by a slightly paler color.

The surface of the cotyledons is moderately rough. The cotyledons— normally two, frequently three, and rarely of a higher number—are creamy-yellow in color and of medium size (Figure 3). The size, however, is uneven: one is almost always longer. In transverse cuts, the cotyledons are usually symmetric, but frequently are asymmetric in form and size. Figure 3 shows the asymmetric growth of the two cotyledonear seeds. Such growth in two cotyledonear seeds seems to be an abnormal phenomenon. Similar asymmetric cotyledonear growth in multi-cotyledonear seed was observed in avocado by Lopez Jimenez and Borys (1989). No explanation can be offered at present for the formation of multi-cotyledonear or for the cotyledons' asymmetric growth. The cotyledons adhere to each other firmly, with a very smooth surface. The point of union of the cotyledons (embryonic axis) is located either symmetrically or asymmetrically. It

may be more or less pronounced in its size. This point sometimes presents an outgrowth with a characteristic thick cylindrical growth (la pata) which is part of the embryonic axis. The first observations indicate that its formation is a prime sign of the initiation of germination. The seeds germinate very well and uniformly.

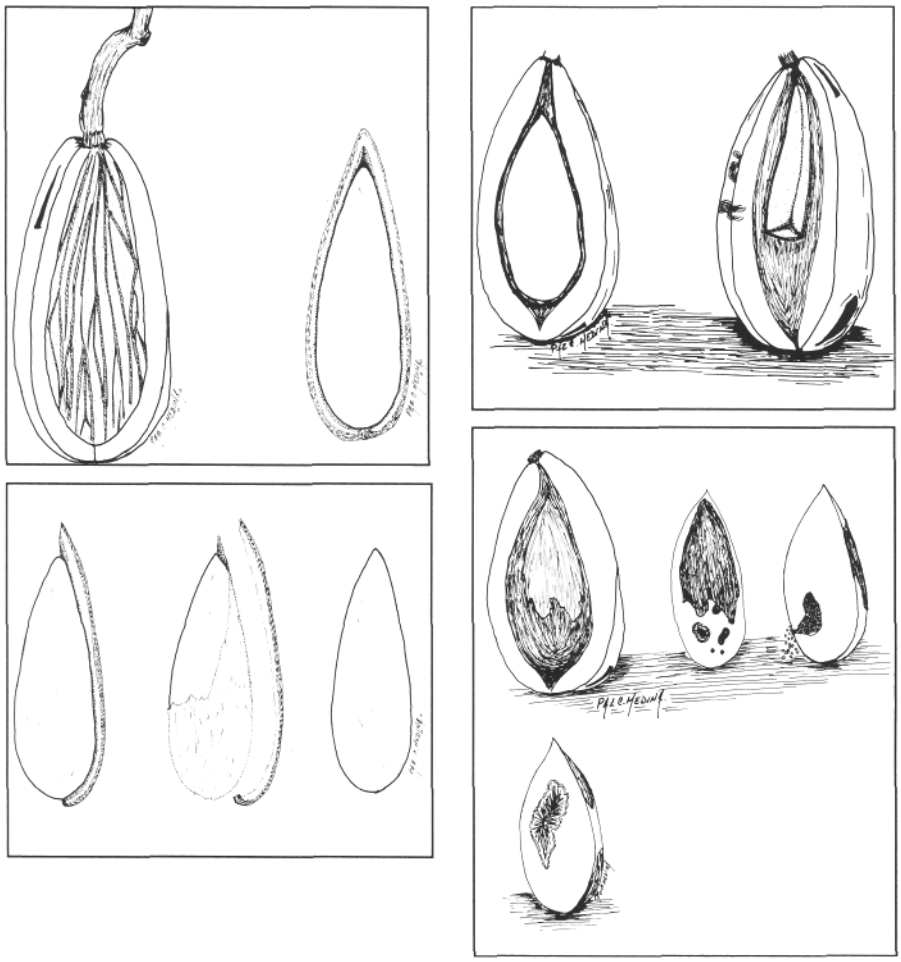

Fig. 2. *A longitudinal cut reveals the pulp and the seed cover and illustrates the comparative relationship of seed to pulp.*

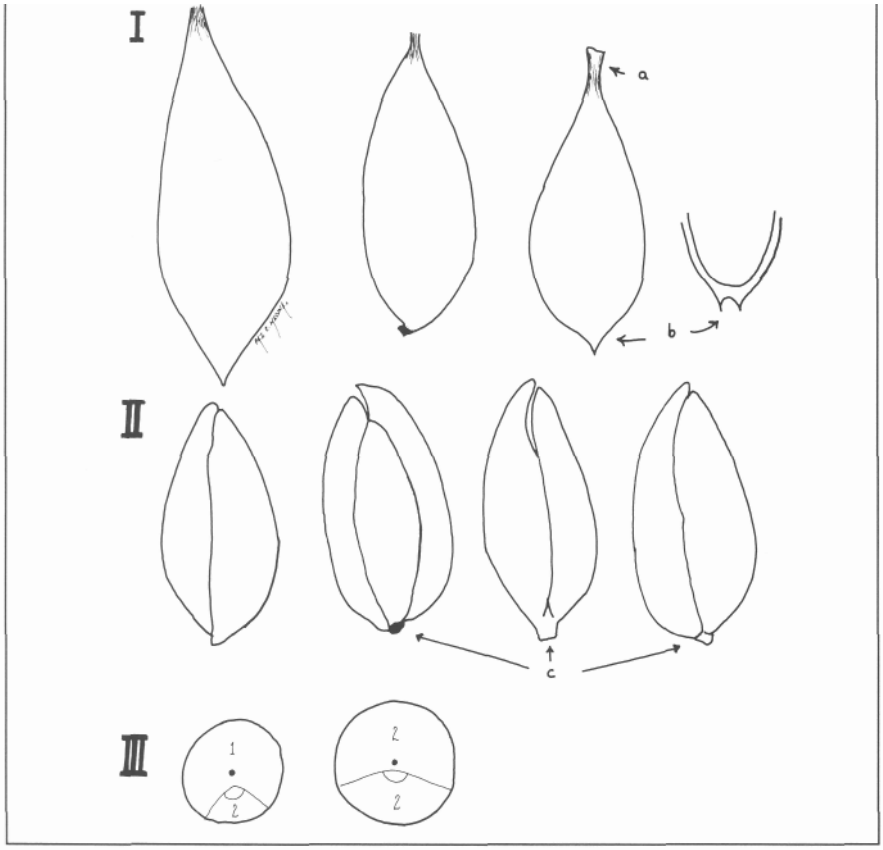

Fig. 3. Schematic drawings of escalan seeds (1:1). Side views with covers (I) with a cylindrical structure connecting to cover with peduncle (a) and its basal part showing one or two points (b) in the cover; (II) without the covers showing the cotyledons' apical parts and cotyledons joined to the foot 'la pata' in its basal parts (c); (III) transverse cut showing one larger and a second much smaller cotyledon. The angle of the second cotyledon increases from 94° at a distance of 1.5 cm to 153° at a distance of 7.0 cm from the seed apex.

Leaf and Twig: Morphological Features.

The shape of mature leaves in the same shoot **(Figures 4, 5; Table** 4) varies from obovate to orbicular to oval, with entire margins, acute bases, acute tips, and pinnate venation. The leaf blade is large, thick, and leathery, with the upper side glossy and the lower side pubescent. The veins on the upper surface are inconspicuous; and in the lower surface, very pronounced, very pubescent, and brown. The leaf petiole is brown, very pubescent, triangular, and with a groove. The surface of the blade is flat or slightly twisted. The leaf length exceeds its width. The number of veins is uneven. The leaf blade's variable form suggests the presence of heteroblasty. The herbarium specimens seen indicate a very wide variation in leaf form and size in B. anay (Blake) Kosterm.

The twig is very hard and strongly lignified, with ridges running along its length, thus making grafting unsuccessful.

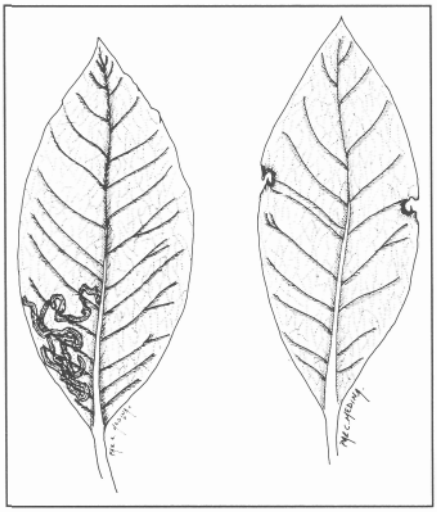

Fig. 4. *Somewhat simplified drawings of fully mature leaf of B. anay (Blake)/ Kosterm., abaxial side. Damage from mining larvae is shown.*

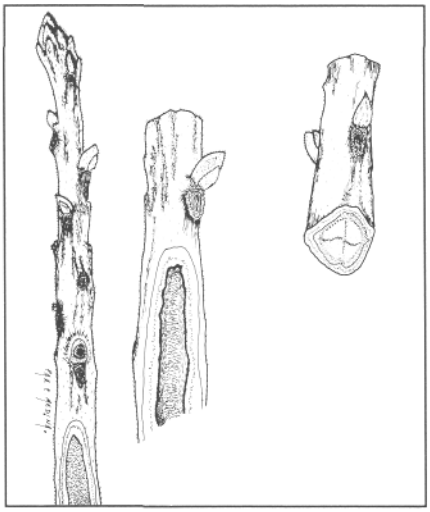

Fig. 5. *Morphological aspects of twig. Note the presence of highly pubescent browny surface of the cortex and bud scales and the large number of buds located near the apex. The longitudinal and transverse cuts show the presence of thick layer of green tissue and a spongy medula with cross-like partition.*

Table 4. Leaf dimensions and vein number in a terminal shoot

	Length (cm)			Blade Width	Veins (#)		Ratio	
	Leaf	Blade (B)	Petiole (P)	(cm) (A)	Left Half	Right Half	B:A	B:P
Mean	27.4	23.7	3.8	12.1	15.3	14.1	1.8	6.3
Minimum	22.8	19.6	3.2	10.6	13.0	12.0	1.5	5.4
Maximum	30.8	26.9	4.5	16.5	18.0	17.0	2.2	7.3
SDn	2.3	2.1	0.4	1.5	1.3	1.3	0.2	0.6

Fruit and Leaf Phytosanitary Aspects.

Both the fruit and the leaves were badly affected by mining insects **(Figures 1,**4). The leaves exhibited two types of "mines"—one visible in the adaxial, and the other in the abaxial, sides of the blade. The first, which normally developed along the leaf margin or between the lateral veins, were much wider. The second developed between the veins, and were narrower. This seems to suggest different feeding habits. The symptoms of mining the fruit epidermis were different (Fig. 1). The fruits were attacked also by a type of microbial infection (Fig. 1) with rather high frequency. Some seeds were damaged by an unknown larva, with resulting rotted fruits and seeds. Both types of symptoms await identification.

The Beilschmiedia Ness, genus has been mentioned a few times as a source of horticultural characters useful for commercial fruit production (4,5,8,11,12). The present report is concerned with the direct usefulness of B. anay as a fruit tree that may replace the avocado or the chinini. The similarity in escalan morphology to avocado suggests such an eventuality.

Certain characteristics in the fruit quality, as well as in root, edaphic, and tree climate requirements that are different from those of avocado, may be useful in promoting the formation of regional plantations of escalan, and may perhaps condition the formation of an endemic, ethnic industry producing specific food sources. This could become a tourist attraction that could raise the income of indigenous populations. Such possibilities do exist (4,5).

The idea of using seedlings of B. anay as rootstocks for Persea americana seems to be unacceptable because of lack of compatibility or difficulties encountered in grafting. Tests to prove the possibility are still running, and final results will become available in two years. Difficulties have also been found while grafting B. anay/B. anay, and the search for a proper grafting technique will continue.

This initial study is in line with the statement by Schroeder (1990) that the search conducted in Lauraceae produced new horizons for the fruit industry by discovering new species of potential value. Considering the wealth of wild species present in Mexico and potentially useful in making a wider variety of fruits available to the populace, that resource should be explored thoroughly. That is the reason for the extensive survey of

Beilschmiedia Ness. In Mexico, it is planned especially to collect B. anay variability in characters of horticultural interest. A study of consumer acceptance is also being considered.

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