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UNITED STATES DEPARTMENT OF AGRICULTURE
MAYAGUEZ, PUERTO RICO

CIRCULAR No. 25

VANILLA CURING

By

FRANCISCA E. ARANA
Collaborating Chemist

Issued May 1945

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[1] In cooperation with the Government of Puerto Rico.

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By FRANCISCA E. ARANA, *collaborating chemist.* [1]

CONTENTS

INTRODUCTION

This circular includes the results of vanilla-curing investigations undertaken at this station since 1938 with funds provided by the Government of Puerto Rico and with the cooperation of staff members of the Bureau of the United States Department of Agriculture now designated Agricultural and Industrial Chemistry. It also includes results of work carried out by other investigators on the different phases of the subject.

Attention is called to Literature Cited, at the end of the circular, which indicates all the sources of information used.

Persons interested in obtaining additional information on the curing of vanilla beans are invited to consult this station for the latest developments.

HARVEST

Mature, green vanilla beans [2] at the time of the harvest are 4 to 10 inches long and have little or no aroma. It is only after the curing process that they become wrinkled in appearance and acquire a dark-brown or chocolate color and an agreeable aroma.

It is desirable to harvest the beans at the proper stage of maturity in order to obtain a commercial product of good quality. Beans that are picked immature become too woody, are readily attacked by molds and mites, and, on curing, develop a low vanillin content and little aroma. On the other hand, if too mature when harvested, the beans are likely to split and consequently command a low market price. Practice enables the grower to determine exactly the stage at which they should be harvested in order that they may develop the best qualities.

[1] In cooperation with the Government of Puerto Rico. (The author is now fishery technologist, Fish and Wildlife Service, U. S. Department of the Interior, Mayaguez, P. R.)

[2] Appreciation is expressed to La Cooperativa de Cosecheros de Vainilla de Puerto Rico and to the Puerto Rico Reconstruction Administration for the loan of the beans which were used in the studies on which this paper is based.

The outside appearance is very helpful in judging the best stage for harvest. When the beans begin to mature they lose their luster and become somewhat dull. The color changes from a natural dark green to a light green. Two well-developed lines are formed from one end of the bean to the other, along which it often splits open. It is best to harvest the vanilla beans when these lines are quite distinct and the outer, or blossom, end, where the bean is thickest, begins to take on a pale-yellow tint. If the color is too yellow at harvest, the amount of splitting in the cured beans will be great.

It should be mentioned, however, that the general appearance of the pods varies with the growing conditions of the plants. Thus, beans exposed to the sun have a pale color. On the other hand, those developed in dense shade remain dark green until they begin to mature. It is necessary to harvest the former when the surface becomes waxy opaque and the yellow coloration appears only slightly at the blossom end.

The beans mature 7 to 9 months after the pollination of the flowers. The harvest, which starts generally in the month of December, lasts from 3 to 4 months. The beans mature separately, almost in the same order in which the flowers were pollinated. At the height of the harvest season it is necessary to inspect the vanillery daily in order to harvest the beans at the best stage of maturity. At the beginning and at the end of the harvest period two or three inspections per week suffice because only small numbers of beans are maturing.

A good method of picking the bean is to hold the base of the stem near the point of attachment to the stalk between the thumb and index finger of one hand while pulling the bean loose with the other hand. The bean should be grasped near the stem end and pulled gently.

CURING OR PROCESSING

On the curing or processing of vanilla depends the value of the marketable product. If the beans are left to mature completely, either on the vines or after harvest, they gradually turn yellow and split. Then they continue to darken until they acquire a chocolate color. Also, if not properly conditioned, they become dry and brittle and develop little aroma.

The curing process can be divided into four stages. The first consists of heating the beans or giving any other killing or wilting treatment that will stop the natural changes in them (*3*).[3] The second step consists of "sweating" the beans, until they become flexible, by drying slowly with either sun or oven heat. The third stage is slow drying, usually at room temperature, until the beans get to the desired dryness. The fourth stage is the conditioning of the beans so that they develop the characteristic fragrance. During this final treatment the beans are kept in closed boxes to avoid too great drying and are examined frequently to detect and prevent molding.

3 Italic number in parentheses refers to Literature Cited, p. 19.

Sun Wilting

Sun wilting or killing is one of the common methods used in Mexico (*6, pp. 90-92*). The beans are first sorted according to the degree of maturity; those which are beginning to darken are wiped with castor oil and cured separately. The following day, the beans are placed in the sun on racks which are covered with dark woolen blankets to hold the heat of the sun. These racks are placed preferably against a white wall which reflects the sun's rays. Before sunset the beans to be sweated are placed in boxes lined with blankets which have also been sunned. The beans are placed with their thick ends together toward the center of the box and covered with the blankets.

When the boxes are opened the following day, the beans have begun to acquire a dark-brown or chocolate color. The beans that have retained completely their green color, or which have an uneven coloration, are treated in ovens and cured separately. The beans are then exposed daily to the sun on the blanket-covered racks during the hottest part of the day for a period of 1 to 2 hours and kept on the racks inside a building when not in the sun. In Mexico this takes 20 to 30 days, but about 17 days are usually sufficient under Puerto Rican conditions. During this period the beans are subjected four or five times to the overnight sweating treatment in boxes described above. Too many sweatings lead to the development of an off color. The beans are finally placed for conditioning in closed boxes for several months to develop aroma.

Oven Wilting

Oven wilting also is used in Mexico (*6, pp. 92-95; 13*). The beans are tied in bundles of 100 to 400, rolled in blankets, and placed for 36 to 48 hours in an oven at a temperature of 60° C. After this period the beans have generally acquired a chocolate color and are then placed in sweating boxes for 24 hours. During the next 20 or 30 days the beans are treated as described under Sun Wilting, the sweating treatment being repeated four or five times also.

Wilting With Hot Water

The wilting procedure most commonly used in the French islands of the Indian Ocean, such as Madagascar, Réunion, and Comores, is exposure to hot water (*6, pp. 96-104*). In the hot-water process the temperature of the water is usually from 60° to 65° C. (140°-149° F.). The beans are placed in baskets and immersed in the water for 2 or 3 minutes, the smaller beans and the splits being subjected to the shorter treatment.

After this treatment the beans are drained and placed in sweating boxes. They are then dried in the sun for a period of 5 to 7 days until flexible and later in the shade in a well-ventilated drier, until the necessary amount of moisture has been lost. They are finally conditioned in closed boxes.

In some localities during the harvesttime the sun heat is not sufficient for drying the vanilla, and therefore driers maintained at a temperature of 45° to 50° C. (113°-122° F.) are used for this purpose.

Wilting by Scratching

In the island of Guadeloupe, after harvest, the beans are scratched slightly, once on each face, by means of a pin attached to a cork ring. The point of the pin does not stick out from the cork more than 2 millimeters (1/12 inch). The beans are placed immediately under blankets in the sun and treated as described under Sun Wilting.

Wilting by the Freezing Process

Killing by the freezing process is a method which has been devised at this station (*4*). The beans are kept in a refrigerator for at least 3 or 4 hours until frozen solid, after which they are removed and allowed to thaw naturally in the air at room temperature.

The beans are then slowly dried in ovens at a temperature of 45° to 55° C. (113°-131° F.) until flexible, after which further drying is carried out at room temperature on screen racks indoors until the desired amount of moisture is lost. Final conditioning of the beans in wooden boxes for a period of about 3 months is the same as for the other processes already described.

Figures 1-3 show an oven, drying racks, and a conditioning box used in the final curing process.

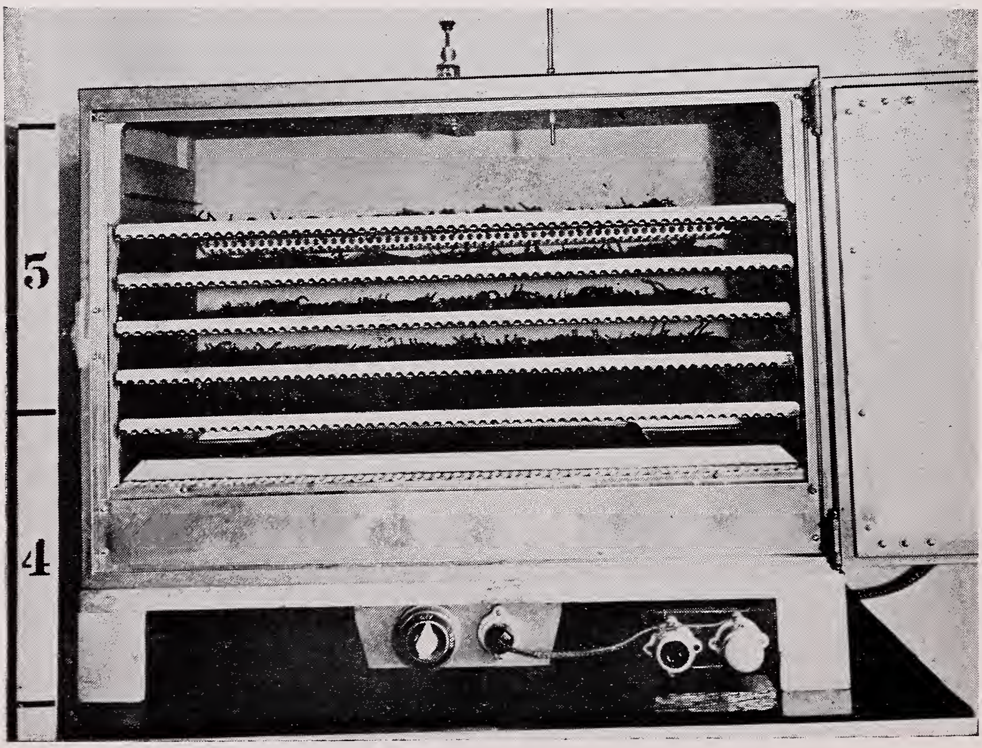

FIGURE 1.—Electric oven for sweating vanilla beans. Oven sweating involves less labor and results in less moldiness.

Wilting With Ethylene Gas

The method of treating the beans with ethylene gas has also been used at this station. However, this gas serves more as a maturing than as a killing or wilting agent. The beans are exposed to the action of ethylene at a concentration of 1 part to

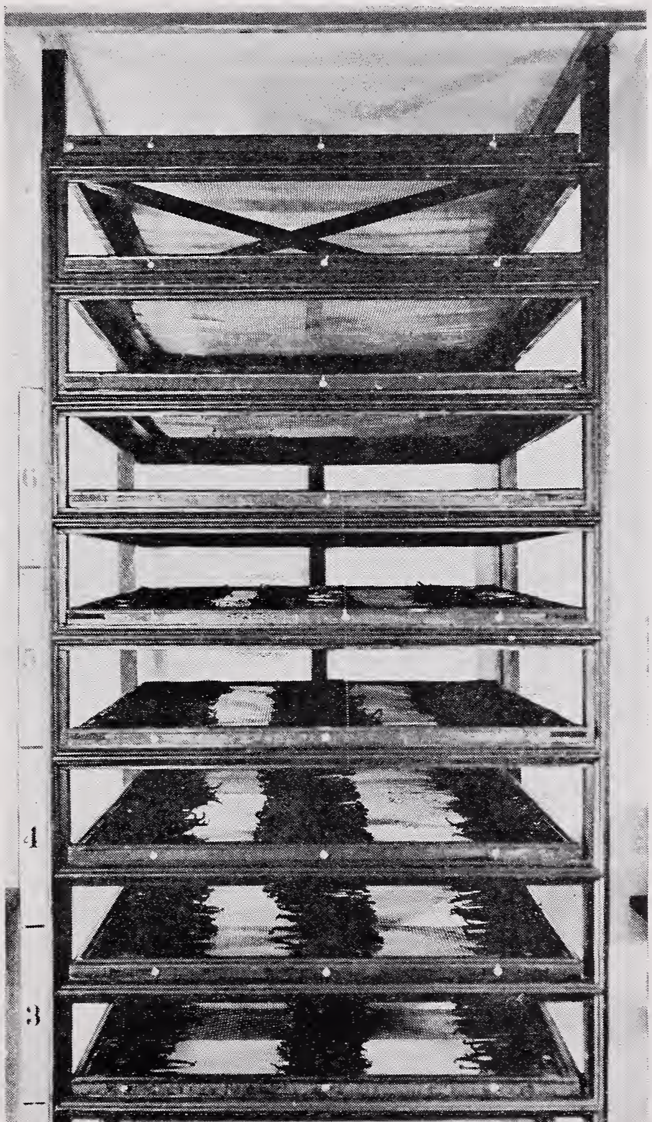

FIGURE 2.—Removable screen racks for the indoor drying of vanilla beans to the desired weight after the beans have been properly sweated.

10,000 parts of air for a period of 8 to 16 hours (*12*). The beans are then sweated in an oven, further dried at room temperature, and conditioned as described in the freezing treatment above.

Evaluation of Different Curing Methods

The killing procedures described above give generally a satisfactory commercial end product.

According to some recent unpublished experimental results, the killing treatment in which the beans are scratched with a pin appears to be better than others, because it requires a short time for sweating and drying and results in high vanillin and phenol values and a low degree of splitting. However, beans cured by this method were highly susceptible to mold and had poor flexibility in the stem ends. These difficulties, as well as the short time taken by the beans to dry, are due to the fact that the beans lose water rapidly as a result of the surface wounds. A modified scratching method not extending to the stem end of the bean might obviate the lack of flexibility in that region. General cleanliness and

FIGURE 3.—Wooden box lined with tin and wax paper for the conditioning and storing of vanilla beans.

proper antiseptics which would not interfere with the flavor and aroma of the beans could probably be used to avoid excessive degree of mold. This method cannot be unqualifiedly recommended but is largely dependent on the skill and care given by the curer.

The beans killed by freezing had practically no mold and a very suave vanilla aroma, but the phenol value, vanillin content, and percentage of splitting were only medium. A practical advantage of freezing, however, is that the vanilla grower or curer can pick the beans at the best stage of maturity and keep them in a refrigerating unit until enough beans have accumulated to cure.

The hot-water killing treatments were satisfactory with very few moldy beans and medium degree of splitting but took longer time in drying and had generally low vanillin content and phenol value. This method is probably the easiest and most satisfactory for the inexperienced curer.

Oven killing required a relatively short time for sweating and drying, did not produce many splits, and gave a high vanillin content. However, a high percentage of the beans were moldy and their phenol value was medium.

The sun and ethylene killing treatments resulted in a high degree of splitting, and the beans molded easily. These two factors lower the market price of the beans.

The use of an oven instead of the sun offers advantages for sweating vanilla beans as it makes less work, takes less time for sweating and drying, and reduces mold.

MOISTURE CONTENT

The moisture in uncured vanilla beans gets less as the beans become more mature. The average moisture content of well-developed beans still having a green color is 81 percent, while similar beans with the blossom ends yellow contain about 79 percent. The moisture content of split beans varies widely. It depends on the extent of splitting and how long a time has elapsed after splitting. Beans that were yellow at the blossom end and had just split were found to contain about 79 percent moisture, split beans with chocolate-colored blossom ends had around 77 percent, and split beans, chocolate-colored all over, about 74 percent.

The moisture content of cured beans from different countries, according to analyses made at this station, are shown in table 1.

TABLE 1.—*Moisture content of cured vanilla beans from different countries.*

Source	Moisture content	Source	Moisture content
	Percent		*Percent*
Mexico	40.3	Tahiti [1]	33.4
Mexico [1]	38.3	Madagascar	31.3
Comores	35.4	Guadeloupe [1]	17.8
Tahiti	37.5	Guadeloupe	15.2

[1] The moisture content of these beans was determined several months after receipt.

It was found that the moisture content of the cured beans affected the quality and development of the vanilla aroma but did not affect the content of phenols, including vanillin (*2*). When cured by different procedures, beans with 50 to 54 percent moisture had a fermented aroma lacking suavity and development; those with 24 to 27 percent moisture had a suave and well-developed aroma but little flexibility, while those with 31 to 34 percent moisture had just as desirable aroma, as well as a high degree of flexibility.

Almost all the loss in weight of vanilla beans during curing is due to the loss of moisture. Other losses due to chemical changes

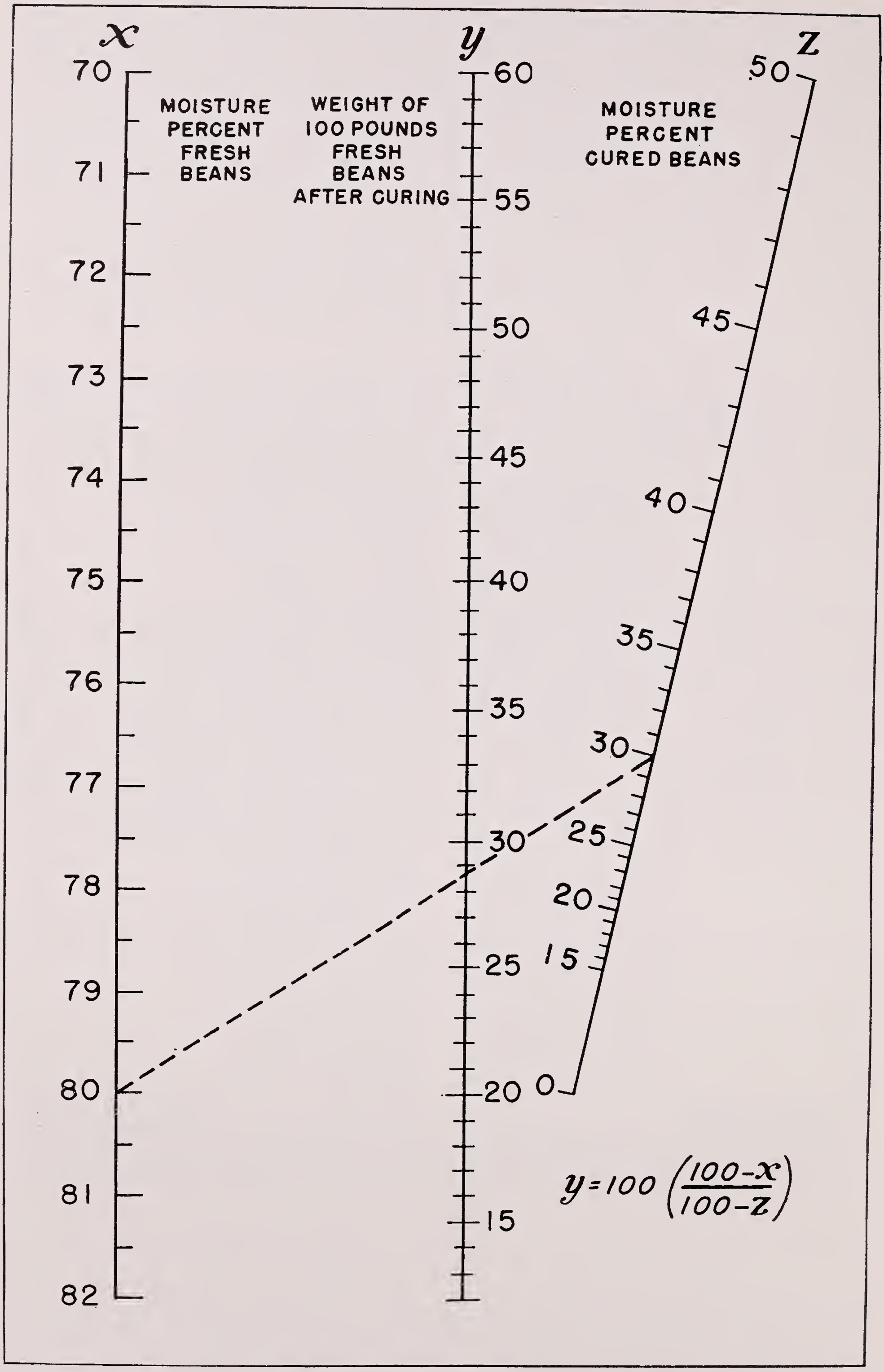

FIGURE 4.—Nomograph by which it is possible to tell how much weight a particular lot of vanilla beans must lose through drying to bring them down to the moisture content desired for best quality when cured. See directions on page 9. (After Merriam A. Jones (2).)

which take place in the beans are negligible (*2*). The greater part of the weight loss takes place during the first stages of curing when the beans are heated either in the sun or in ovens and dried in the shade indoors. A small loss occurs in the final conditioning when the beans are kept in closed boxes for several months. This loss in weight depends principally on the moisture content of the beans at the beginning of conditioning, on the number and length of the periods of time taken in examining the beans, and on the amount of wiping to remove the mold. The following losses may be considered approximate per 100 pounds of fresh beans: For 30 to 40 percent moisture in the final product, from 4 to 7 pounds; for 20 to 30 percent moisture, from 1 to 3 pounds.

Nomograph and Directions for Moisture Calculations

Figure 4 shows a nomograph for determining the weight to which any particular lot of vanilla beans should be reduced during curing in order to obtain whatever moisture content is desired in the cured product (*2*).

The following are directions for using the nomograph:

1. Classify the beans in different lots according to maturity.
2. Ascertain the approximate water content of the different lots following data given on page 7. Example: Assume 80 percent water content.
3. Determine water content wanted in cured beans. Example: Assume 30 percent.
4. Calculate from data given on page 9 the loss in weight during conditioning for beans with a final water content of 30 percent. Example: A 100-pound lot would lose approximately 3 pounds during conditioning.
5. Draw a straight line from point 80 on the first reference line at the left to point 30 on the inclined line at the right.
6. Read then on the central line the final weight of the beans after curing, including conditioning, which equals 28.6 pounds.
7. Add 3 pounds, or the loss during conditioning (part 4 above), to 28.6 pounds to obtain the weight to which the beans should be reduced before conditioning. This figure would be 31.6 pounds.

Therefore, every 100 pounds of green beans should be sweated and dried until they weigh 31.6 pounds. After 3 months' conditioning the weight would be reduced to 28.6 pounds and the cured beans would contain about 30 percent water.

Another example is given using a 100-pound lot of blossom-end yellow beans which contain in the fresh condition about 79 percent water. Assume in this case that a final water content of 35 percent is desired in the cured beans. The loss in 100 pounds of these beans during conditioning would be about 5 pounds.

Therefore, trace the line in the nomograph from point 79 on the first reference line at the left to point 35 on the inclined line at the right. Read then on the central line the final weight of the beans after curing, including conditioning, or 32.5 pounds. Add the loss during conditioning, or 5 pounds, to 32.5 pounds to obtain the weight to which the beans should be reduced during conditioning, amounting to 37.5 pounds.

Therefore, every 100 pounds of blossom-end yellow beans should be sweated and dried until they weigh 37.5 pounds and then placed in the conditioning box, where they will lose approximately 5 pounds more and have, therefore, a final weight of 32.5 pounds. These beans would contain approximately 35 percent water.

MOLDINESS

When vanilla beans are improperly cured or contain a high percentage of moisture they are readily attacked by molds. Molding occurs generally during the conditioning and storage periods and always begins at the stem end of the beans. If the infection is not controlled, the whole bean becomes wrinkled and dry and acquires a disagreeable odor. Such a product commands a lower market price than beans that have not molded.

It has been observed that the mold develops most frequently on beans that are harvested before they are mature. Favorable conditions for mold development are created when the killing treatment is not entirely effective because then the beans do not dry uniformly. Sweating and drying the beans in the sun rather than in ovens, as already mentioned, increase the contamination by mold. The use of dirty blankets and general lack of cleanliness and ventilation in the curing room are also other factors that contribute to moldiness.

Mold can be controlled by wiping the affected portion with a cotton swab or cloth wet with 95-percent alcohol. In the French islands of the Indian Ocean a 3-percent solution of 40-percent formaldehyde is also used, and the beans are then kept in driers for several days (*6, p. 104*).

If the beans are examined frequently during the periods of conditioning and storage, the moldy ones can be treated at once, and the spread of the mold can thus be prevented. If the mold has taken hold too strongly it is better to cut off the infected portions of the beans.

In Mexico, if the mold is not too bad, it is customary to follow the cleaning by wiping the beans with the "balsam," or oily, substance that is given off by the very mature beans. If the mold has taken a good hold, the beans are immersed in hot water for 1 hour (*6, p. 94*).

Another easy precaution is to warn the persons doing the packing not to put in their mouths the strings used to tie the bundles. In some countries it is customary to put glycerine on the strings after the packing is finished. When severe mold attack occurs, the room and all the equipment used in curing should be thoroughly sterilized. This is also recommended in order to destroy mites.

CLASSIFICATION AND PACKING

After being conditioned, the beans, which are usually bent and wrinkled, are straightened by pressing them one by one between the thumb and the index finger of one hand while pulling with the other hand. The contents of the beans are spread along evenly in this way, and it helps also to improve the appearance.

The beans are first sorted into the following classes: (1) Whole beans free of all defects, (2) whole beans very dry or spotted, and (3) split beans.

The beans of each class are then measured and further classified according to size, each size being packed in separate bundles. In Mexico those that are too small, broken, or otherwise imperfect are usually cut into small pieces and sold as "cuts."

For packing, the better-looking beans are selected for the outside and the straightest ones for the center of the bundle. The other beans are then placed stem ends together, 50 to 70 beans in each package. Each package is then tied with two turns of black string at the center and at each extremity. To make it easier to examine the beans, it is customary to remove the ties from the ends of the bundles of Bourbon vanilla beans before export from Madagascar and Comores. Types of packages of vanilla from different countries are shown in figure 5.

FIGURE 5.—Types of packages of vanilla beans from different sources. From left to right—Mexican, Bourbon, and Puerto Rican.

The packages are placed finally in tin cans which are lined with wax paper to prevent the beans from coming in contact with the metal. Packages of beans of only one quality are placed in any one can, and the number of bundles, length of the beans, total weight, and year of the crop are shown on the label. The cans are then packed in wooden boxes.

FIGURE 6.—Uncured vanilla beans showing the outside of the whole bean, the bean cut open lengthwise, and the bean cut across. The glucoside, which produces the vanillin, is found throughout the outer fleshy portion, or ovary wall, and the central portion which includes the seeds. The enzyme which changes the glucoside into vanillin is present only in the fleshy part.

CHEMISTRY OF VANILLA

The vanilla bean is composed of a central portion containing the seeds and seed-bearing tissue surrounded by a fleshy part, or ovary wall. Figure 6 shows lengthwise and crosswise sections of the uncured vanilla bean.

The ripe beans have little or no aroma before curing. The aroma and flavor develop as a result of changes which take place during this process. The chemical substance from which vanillin, the principal constituent of vanilla, is formed occurs in uncured beans in the form of a glucoside called glucovanillin. In the curing of mature beans this glucoside is broken down or hydrolyzed to vanillin and glucose by the action of an enzyme of the nature of a beta-glucosidase (*1*). The hydrolysis of other glucosides present in the beans yields other aromatic compounds which add to flavor and fragrance (*9*). In entirely green beans the beta-glucosidase enzyme does not get to work during the curing process, and hence such beans have a low vanillin content and do not develop a desirable aroma.

The heating or freezing treatments in the curing process work on the microscopic cells that make up the flesh of the beans in such a way that the enzyme, which they contain, can get out and act upon the glucovanillin which occurs throughout the whole pod.

Cured vanilla beans contain from 1 to 4 percent of vanillin. This substance begins to appear in the form of crystals on the surface of the blossom end of the pods during the conditioning period, eventually covering about two-thirds of the surface of the beans. This portion is more mature than any other part of the pod, and the crystallization occurs there because the material from which vanillin is formed is present in larger quantities and the enzyme beta-glucosidase that does the work is probably more active in that region. Figure 7 shows cured vanilla beans with the characteristic vanillin crystallization.

Part of the vanilla aroma is due to small quantities of volatile oil. The volatile oil of Bourbon vanilla consists in part of esters and other derivatives of cinnamic acid (*7*). That of the Tahitian vanilla consists principally of anisyl alcohol and aldehydes and esters of anisic acid (*17*). The Tahitian vanilla, as well as the vanillons of *Vanilla pompona,* contain piperonal or heliotropin, which imparts a characteristic aroma that differs from that of any other type of vanilla (*8*). Cured vanilla beans also contain vanillic acid, tannins, resins, coloring matter, sugars, gums, fats, waxes, cellulose, and minerals (*14, p. 795; 15, pp. 613-614*).

Pure vanillin is manufactured by a chemical process from eugenol, the principal constituent of clove oil and bay oil; from guaiacol, a coal-tar product; or from lignin, a byproduct of the wood-pulp industry. The synthetic product is identical with natural vanillin. A vanillin solution, however, cannot be compared favorably in flavor and aroma with an extract of natural vanilla because in the natural product the other aromatic substances that are present modify pleasantly the aroma of the vanillin. More complete information on the chemistry of vanilla can be obtained from Federal Experiment Station Bulletin No. 42, Vanilla Curing and Its Chemistry.

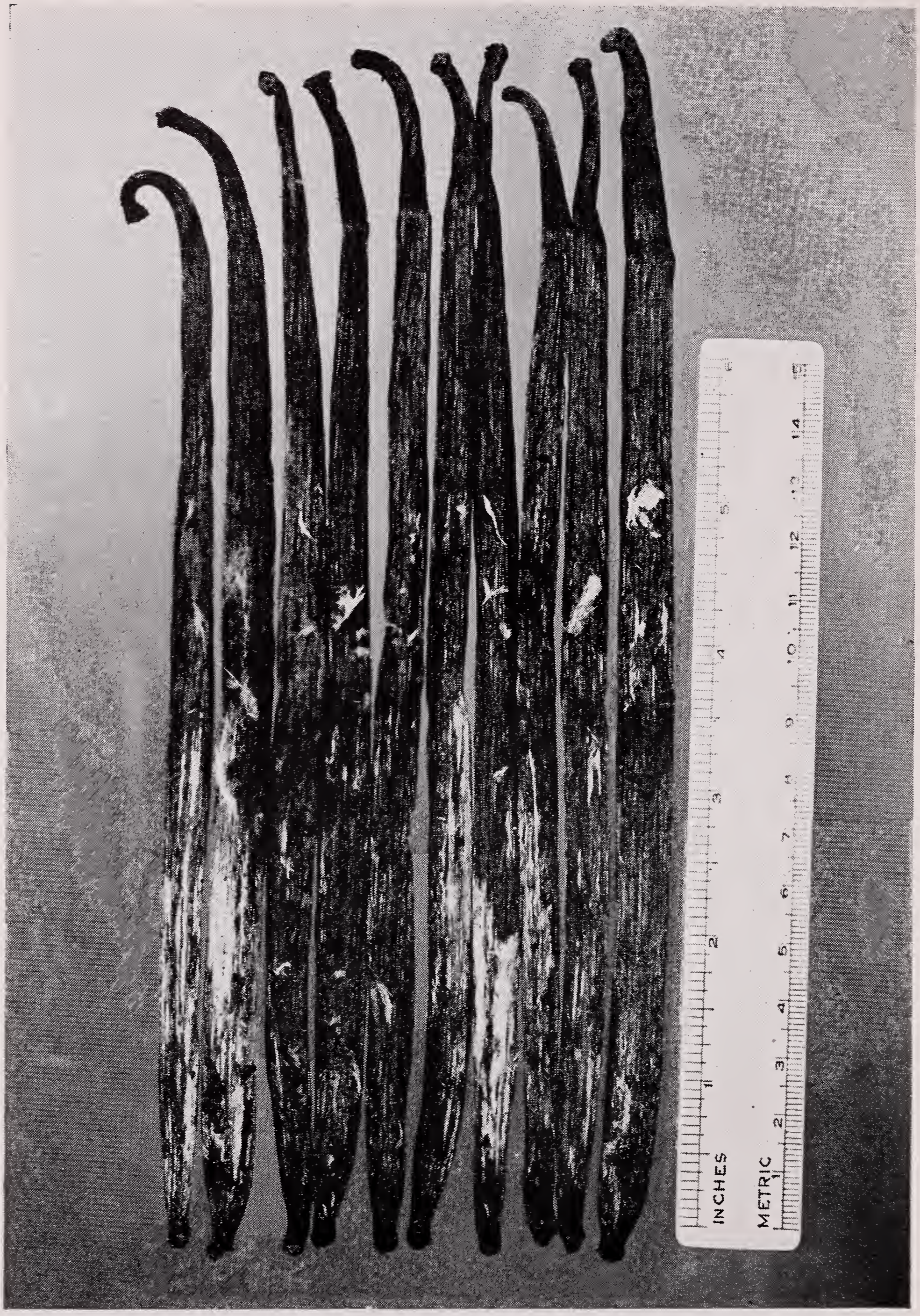

FIGURE 7.—Cured vanilla beans showing the vanillin crystals on the lower two-thirds of the pods. Glucovanillin was found to be present in largest quantities in the blossom end of the pod, decreasing gradually toward the stem end.

COLOR

The color of the uncured vanilla bean is green, a yellowish coloration being produced as it gets more mature. Hot alcoholic extracts from the outer, fleshy portion of the uncured bean were green in color, which showed the presence of chlorophyll. Similar extracts from the central seed portion including seeds and seed-bearing tissue were yellowish red. Thus coloring matter, other than chlorophyll, is present in the central portion of the beans. The color of the cured bean is usually dark brown or chocolate, and that of its alcoholic extract is usually brownish red. Mature, green beans that are completely green when harvested produce the darkest and blackest cured product, while the more mature beans, such as those which are split and have a yellow or chocolate color, become reddish brown after curing. However, the blackest beans always produce the lightest-colored extracts, the color of the extract becoming deeper with more mature beans.

VANILLA POISONING

The name of "vanillism" is given to a form of poisoning which sometimes appears in persons who work with vanilla. It is shown usually by effects on the skin or else by general characteristic symptoms.

The effects on the skin are produced principally by the latex juice of the green plant. This liquid oozes from the extremities of the cuttings during the work of planting, from the petals of the flowers which break off during pollination, and finally from the beans during harvest and when they split. This juice generally causes in sensitive persons a local skin irritation which produces red patches accompanied by itching and sometimes by swelling. The itching and swelling disappear after 2 or 3 days, unless the person comes in contact with the liquid again, although the patches disappear only after a longer period. If the latex gets into the eyes, it produces a severe irritation accompanied by itching, strong secretion, and inflammation of the eyelids. Figure 8 shows the skin eruption produced by putting vanilla latex on the forearm of a person in an experiment to show its poisonous nature.

The general symptoms of vanilla poisoning often appear while the beans are being handled during the curing process, especially during the last stage of the process when the crystals of vanillin begin to appear on the surface of the beans. In such cases an eruption appears on the hands, arms, neck, and face of susceptible persons and is accompanied sometimes by headache, fever, and intestinal disorders. These symptoms, however, are generally temporary, lasting only 3 or 4 days. More severe attacks from improperly cured or moldy beans or from imitation products have been recorded in other countries (*6, p. 155-164*).

The effects of the latex of the green plant are generally attributed to the presence of calcium oxalate. When the latex is observed under the microscope, numerous needle-shaped crystals can be seen. However, these crystals have not been identified chemically. In the case of the cured beans the toxicity is due apparently to vanillin, since a similar reaction is produced by synthetic vanillin (*10*).

It has been observed, however, that these poisonous effects diminish generally as the persons get used to handling vanilla.

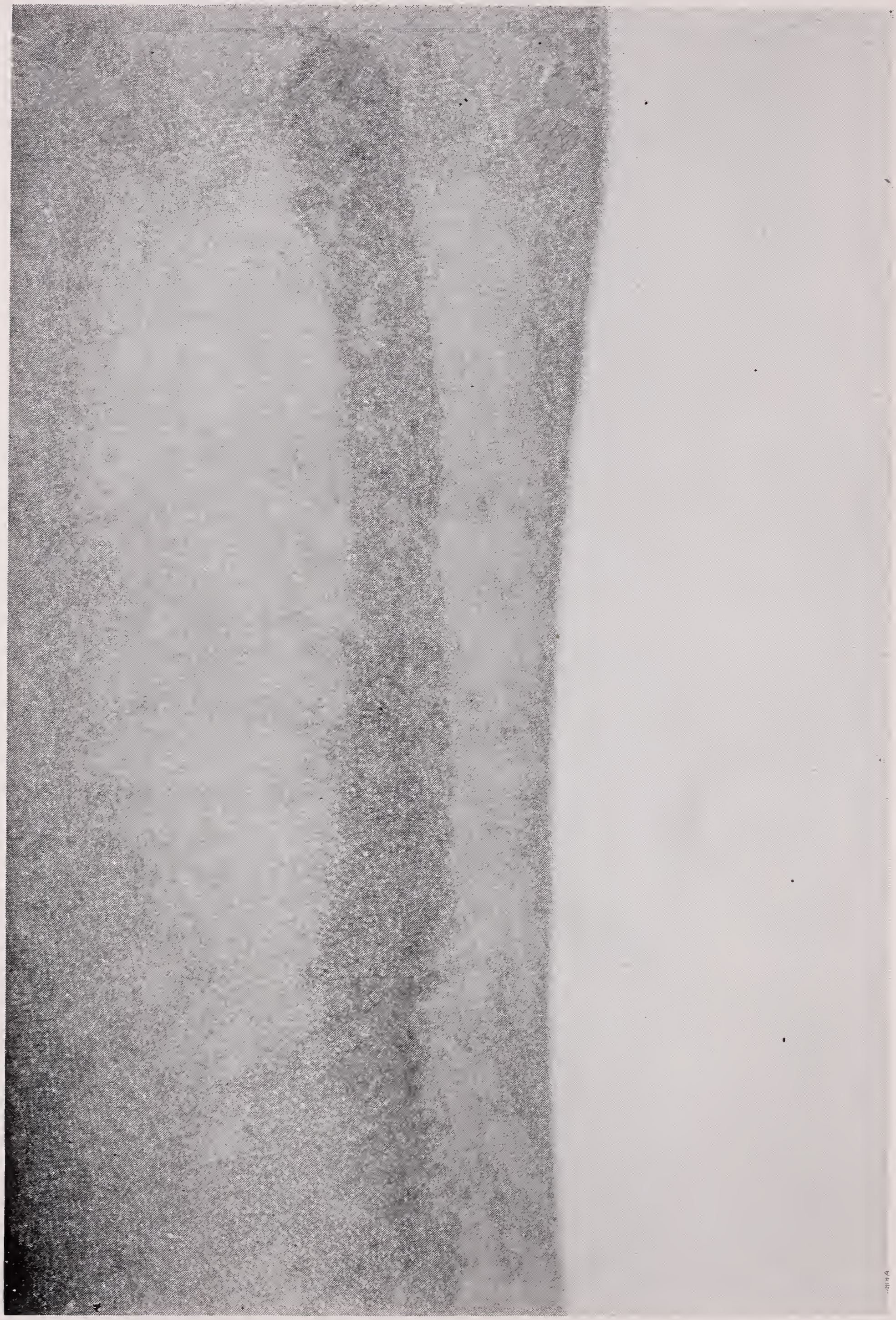

FIGURE 8.—Skin eruption produced 1 hour after the milky juice of vanilla was put on the forearm of a susceptible person in an experiment to prove that it may have poisonous effects.

If a person is very susceptible to these affections, he should use rubber gloves as a precaution. The hands and other exposed parts of the body should be washed carefully after work, preferably with dilute alcohol.

USES OF VANILLA BEANS

The most important use of vanilla is in the form of alcoholic extract to give flavor to foods, candies, ice cream, beverages, and tobacco. It is sometimes used also in the manufacture of liqueurs and perfumes. The Tahitian vanilla and the vanillon, both of which contain heliotropin, have been used in the preparation of heliotrope perfumes, although synthetic heliotropin now is replacing these products.

Sometimes the natural and the synthetic products are mixed in various proportions. A mixture of synthetic vanillin, extract of Tonka beans, coumarin, and caramel is sometimes used as a substitute for the pure extract. However, according to the specifications of the Federal Drug and Cosmetic Act, only the extract prepared from vanilla beans can be labeled "Vanilla Extract." Any imitation product must specify on the label "Imitation" and must list the ingredients used.

Sometimes the beans themselves, instead of the extract, are used for flavoring and are sold as such in glass tubes. Concentrated extracts, which are known as vanilla oleoresins, are now on the market. There is also a great demand in the United States for vanilla sugar, which is prepared by mixing the ground vanilla beans or the oleoresins with powdered sugar. For the preparation of these products, split beans, being more highly aromatic, are preferred by some experts in the trade to beans of better appearance.

PREPARATION OF VANILLA EXTRACT

According to the Federal Standards of Purity for Food Products (*16*), vanilla extract is prepared with or without sugar or glycerin and contains in 100 milliliters the soluble matter from not less than 10 grams of vanilla beans. Therefore, for the preparation of 1 gallon of extract 13.35 ounces of beans are required, but many manufacturers employ as many as 14, 15, or 16 ounces to the gallon.

The beans are cut into bits small enough to pass through a sieve having eight or more meshes per inch. Various kinds of knife choppers on the market are suitable for this purpose. The beans cannot be ground in a machine because this raises the temperature enough to cause some of the aromatic compounds to decompose.

The best grade of ethyl alcohol, known commercially as Cologne spirits, is the solvent generally used for extraction. Ordinary industrial ethyl alcohol must be purified before it can be used for this purpose. It has been found (*5*) that the solvent should contain from 47 to 50 percent of alcohol by volume and that distilled or soft water should be used to dilute it. Allowance has to be made for the fact that when alcohol and water are mixed a contraction in volume takes place. The finished extract can be diluted further to 40 percent alcohol, allowance being made for this by using an increased quantity of vanilla beans.

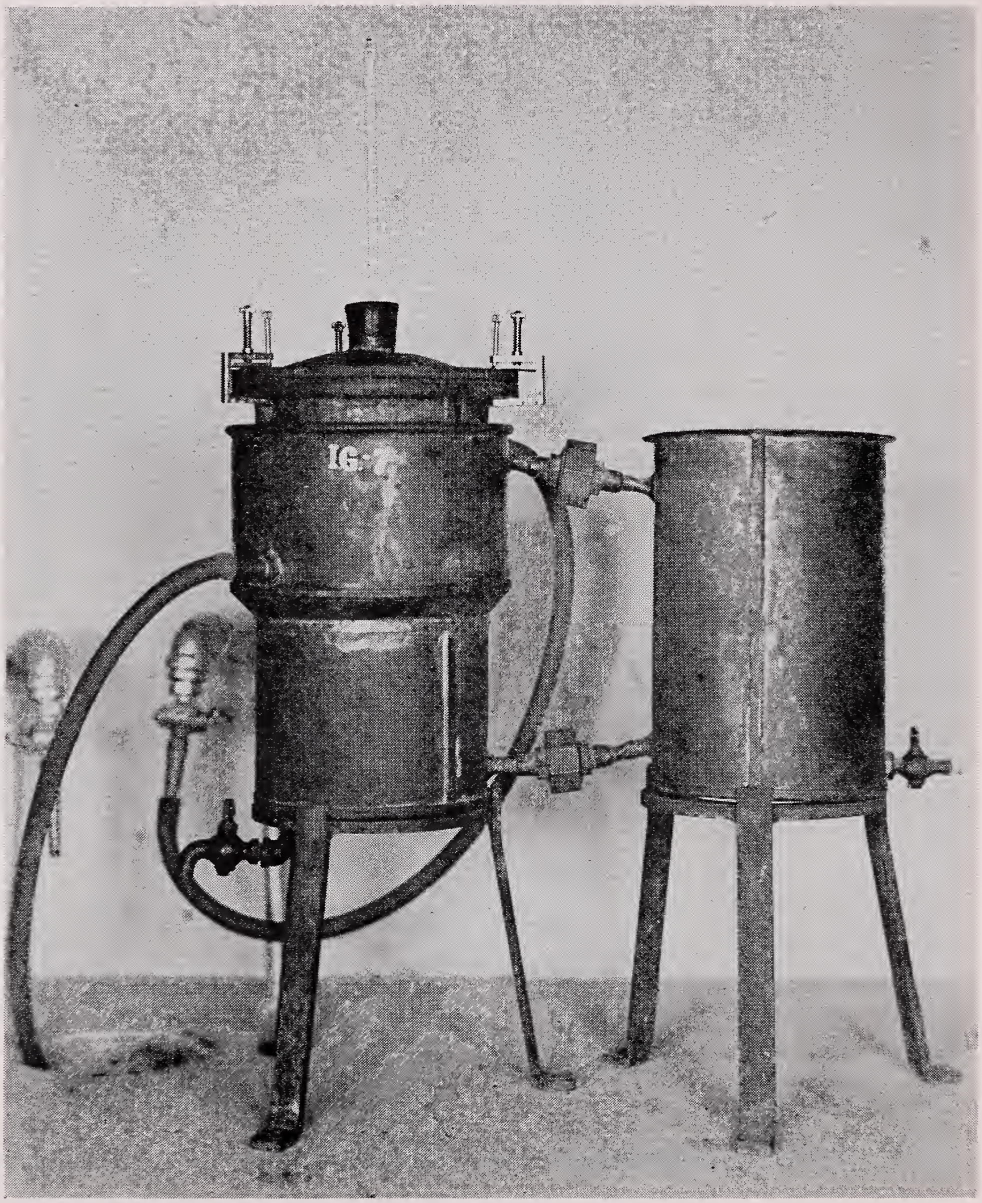

FIGURE 9.—Miniature 1-gallon percolator used for vanilla extraction. The finely cut beans are placed in a perforated container on the upper part of the percolator, and the solvent in the lower part. The temperature of the solvent is kept between 43° and 49° C. (109° - 120° F.) by means of the water jacket at the right.

The most important processes used in the extraction of vanilla are maceration and warm percolation. The process of maceration formerly used consisted of introducing the beans into a nearly airtight container, adding the solvent, and stirring from time to time over a period of 4 to 6 months. Nowadays, by the use of a mechanical macerator (*11, p. 32*) complete extraction of the vanilla bean is obtained in 3 to 4 days.

The warm-percolation process is accomplished by extracting the finely cut beans in a percolator. The beans are placed in a perforated container located near the top of a closed cylinder holding the solvent. The solvent is circulated continuously through the beans by means of a small centrifugal pump. The extraction is carried out at a temperature of 43° to 49° C. (109°-120° F.). The percolator either is placed directly over a small flame or is water-jacketed and warmed by the circulation of warm water. Tin has been found to be the least susceptible of the common metals to the action of vanilla and therefore is recommended in the construction of the percolator. Figure 9 shows a miniature 1-gallon percolator used for the extraction of small lots of vanilla in the laboratory.

Kessler and Higby (*11, pp. 39-40*) give the following formula for the preparation of commercial vanilla extract:

For vanilla beans, cut fine, 83.5 pounds.

	Gallons
Use:	
Cologne spirits, 192 proof	42.7
Water	34.6
Total	77.3
Less shrinkage	2.8
Total extract	74.5
Dilute:	
Total extract mentioned above	74.5
Pure granulated cane sugar, 40 pounds	3.0
Water	24.5
Total, solvent and diluent	102.0
Extract retained in beans	2.0
Finished extract, alcohol content 40 percent	100.0

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RECOMMENDED PRACTICES FOR CURING VANILLA

1. Harvest the beans when the outer or blossom ends are yellow.
2. Wipe the beans with a damp cloth.
3. Kill the beans by any one of the following methods. These are recommended for their simplicity and satisfactory results.
   (a) Immersing in water at 65° C. (149° F.) for 3 minutes.
   (b) Freezing solidly in a refrigerator and then thawing at room temperature for 1 or 2 hours.
   (c) Holding in an oven at 60° C. (140° F.) for 24 hours.
4. Sweat the beans by heating, preferably in an oven, continuously at a temperature of 45° to 50° C. (113°-122° F.) until flexible. If the use of an oven is not possible, sweat them in the sun as described under Sun Wilting.
5. Dry the beans on racks at room temperature until they have lost the amount of water desired.
6. Use the nomograph described for the water calculations.
7. Condition the beans for about 3 months in wooden boxes, lined with wax paper.

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