37-45

STATUS In Transit	**TYPE** Copy	**OCLC #** 173876937	190746989
SOURCE ILLiad	**REQUEST DATE** 10/04/2018	**NEED BEFORE** 11/03/2018	
BORROWER BRL	**RECEIVE DATE**		**DUE DATE**
LENDERS *ZAP, CUV, PUL			

BIBLIOGRAPHIC INFORMATION

LOCAL ID
AUTHOR University of Puerto Rico (Rio Piedras Campus). Agricultural Experiment Station.
TITLE Annual report.

IMPRINT San Juan, P.R. 1910-1944.

ISBN

ARTICLE AUTHOR R. Arroyo,F. Marrero, and L. Igaravidez

ARTICLE TITLE The Birectifier in rum manufacture

FORMAT Government Document
EDITION
VOLUME
NUMBER
DATE 1939
PAGES 37-45

SERIES NOTE Bolefin (Puerto Rico. Insular Experiment Station)

INTERLIBRARY LOAN INFORMATION

ALERT

VERIFIED <TN:519360><ODYSSEY:192.80.65.228/ILL>
MAX COST OCLC IFM - 20.00 USD
LEND CHARGES OCLC IFM - 15.00 USD
LEND RESTRICTIONS n/a

BORROWER NOTES MaxCost: 20. Please conditional if more.

AFFILIATION LVIS, Lyrasis code signers
COPYRIGHT US:CCL

SHIPPED DATE 10/08/2018
FAX NUMBER
EMAIL interlibraryloan@bpl.org

ODYSSEY 192.80.65.228/ILL
ARIEL FTP
ARIEL EMAIL

BILL TO INTERLIBRARY LOAN
BOSTON PUBLIC LIBRARY
700 BOYLSTON ST.
BOSTON, MA, US 02116

LENDER NOTES (lendingCharges: $15.00)

SHIPPING INFORMATION

SHIP VIA MA Libs -- MA delivery routes, Others -- USPS,
SHIP TO INTERLIBRARY LOAN
BOSTON PUBLIC LIBRARY
700 BOYLSTON ST.
BOSTON, MA, US 02116

RETURN VIA n/a
RETURN TO NRLF ILL/University of California
1301 So. 46th Street/RFS-400
Berkeley Global Campus/RFS-400
Richmond, CA, US 94804-4698

$B 73 826

10/9/18
WCT
7pg.

BRL

UNIVERSITY OF PUERTO RICO
AGRICULTURAL EXPERIMENT STATION

ANNUAL REPORT

for the

FISCAL YEAR

1938-1939

by

J. A. B. NOLLA
Director

Part II

Current economic problems

Assistance was rendered and reports were prepared by the staff members during the year on the following problems: (1) effect of the proposed Federal Trade Agreements with Cuba for sugar and tobacco on the prices of these products in Puerto Rico; (2) the effect of the Wage and Hour Law on the canning industry in Puerto Rico; (3) the coffee surplus in Puerto Rico; (4) Puerto Rico's food supply importations and local production; and (5) mortgage debt situation on coffee farms.

TABLE 6

Home tenure and rental payments in Puerto Rico, 1938 averages for 22 municipalities

INCOME GROUP	NUMBER OF FAMILIES	HOME TENURE		RENTING FAMILIES		
		Own homes	Rented homes	Average yearly income	Average yearly rent	Income spent for rent
		percent	*percent*			*percent*
Less than $300	547	76	24	$201	$48	24
$300–$599	565	72	28	436	84	19
$600–$1,199	482	61	39	849	134	16
$1,200 and over	307	68	32	2,085	244	12
All groups	1,901	70	30	$798	$119	15

CHEMISTRY

The Birectifier in rum manufacture. The manufacture of a good rum necessitates the constant supervision of the biological and chemical process involved. The Birectifier of Dr. Curt Luckow of the Berlin Institute of Fermentology, is an invaluable apparatus for the evaluation of commercial and aging rums. This Station has imported one of these Birectifiers to make fractional distillations of rum samples which will reveal the true nature and constitution of the beverage under examination, and at the same time will indicate under expert management whether or not the rum is a genuine product. It is also of invaluable assistance in following the maturing process of aging rums. Its use has been of great help in our rum researches and we recommend it to those interested in the manufacture of rum or similar distilled spirits.

An idea of the work that is done with the help of this apparatus will be obtained by a perusal of the general conclusions arrived at after the fractional distillations of over 20 samples of genuine rums in our laboratory:

1. The greater part of the low boiling point esters and aldehydes are obtained in the first two fractions distilled, probably in azeotropic

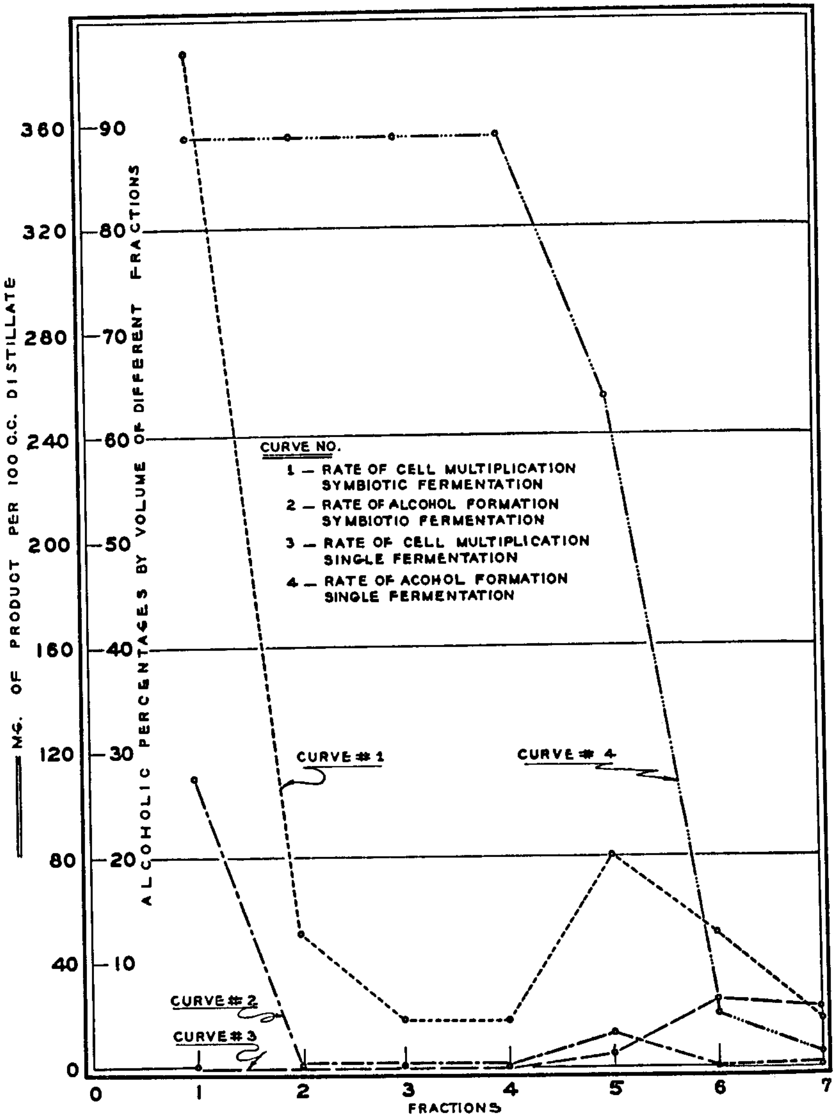

FIG. 12. Curves showing analytical data of high quality rum. Obtained through fractional distillation.

mixtures with the ethyl alcohol. These first distillates, although intensely aromatic, lack the original scent of the sample under fractionation.

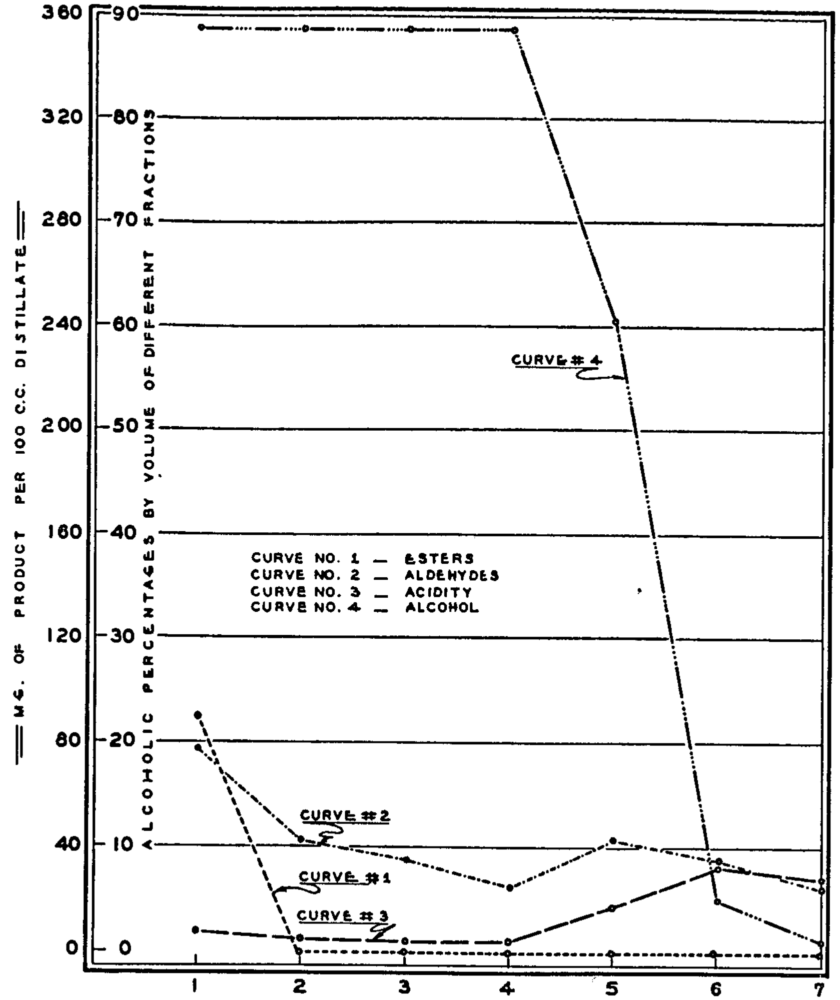

FIG. 13. Curves showing analytical data of a poor quality rum. Obtained through fractional distillation.

2. During the distillation of the second half of the third fraction ascending temperatures of distillation are registered. This indicates that chemical compounds of higher molecular weights begin to pass over at this point, especially the higher alcohols congeneric of ethanol.

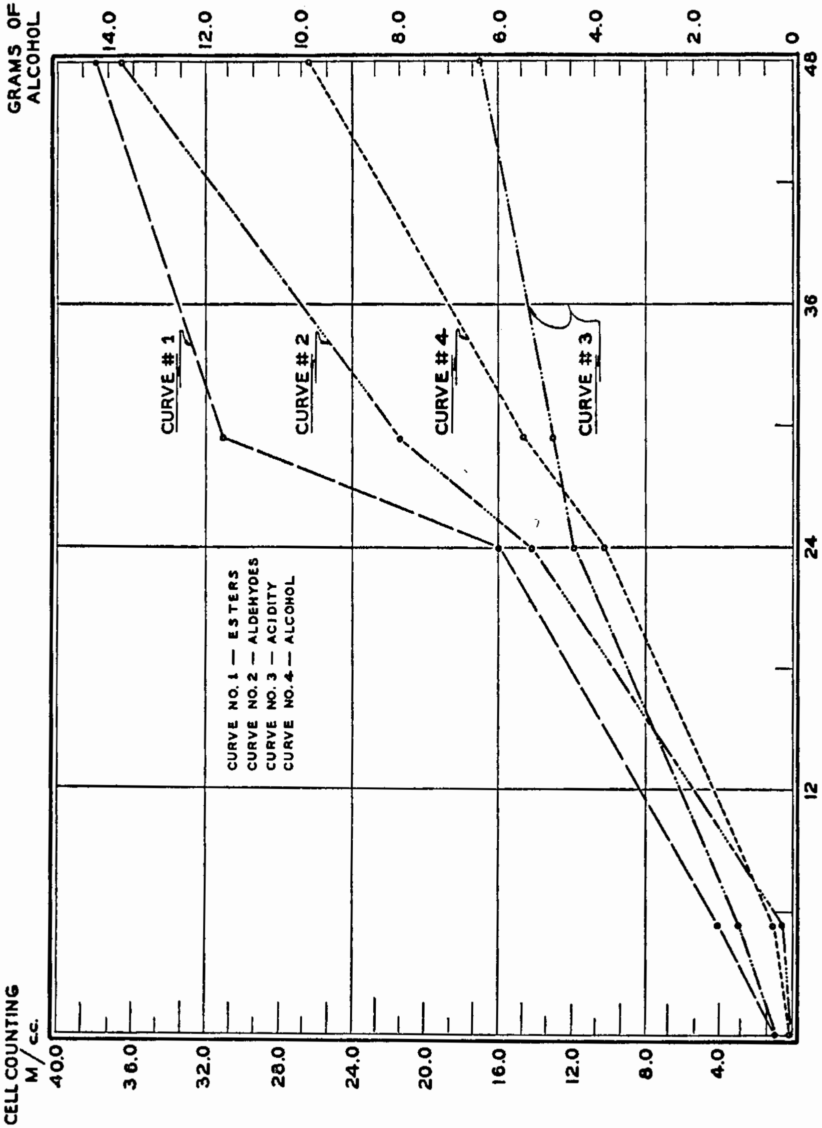

Fig. 14. Curves showing the effect on the rates of yeast cells multiplication and alcohol formation under single and symbiotic fermentation.

3. Still higher boiling point bodies pass over during the distillation of the 4th, 5th and 6th fractions. Some of these bodies prove to be insoluble, or only partly soluble in water, as starting with No. 5 fraction great turbidity is first noticed, and later on standing, oily drops may be seen floating on the surface of the distillate. This oily substance is what we call rum oil. It is one of the most valuable constituents of a genuine rum, especially of the Jamaica type.

4. Fractions Nos. 7 and 8 are devoid of ethyl alcohol; but very high boiling point esters and aldehydes still persist in these last two portions of the distillate. Usually the turbidity of the distillate disappears in these two last fractions.

5. The characteristic aromas of fractions Nos. 4, 5 and 6 recall better than those of any other fraction the original bouquet of the sample under fractionation. This is especially so in fraction No. 5. The highest molecular weight esters and aldehydes are also obtained during the distillation of fraction No. 5. (See figures 12 and 13.) (*Rafael Arroyo, F. Marrero* and *L. Igaravídez.*)

Radiant energy from bacterial cells new factor in symbiotic phenomena. Work conducted in the delucidation of certain phenomena encountered during symbiotic fermentation between yeast and bacteria in rum manufacture, led to the discovery of an important factor in symbiosis among microorganisms.

It was found that the bacteria had the power of inducing a high rate of multiplication and metabolism on the yeast cells with which they grew. The enzymal activities of the yeast cells were greatly activated resulting in a more rapid destruction of the sugars with subsequent appearance of the metabolic products of yeast fermentation. In certain cases morphological changes were observed resulting in a striking swelling of the cells, giving them the appearance of the so-called giant cells; the youthful cycle of the yeast cells during fermentation being also prolonged.

The most striking observation made in these studies was the fact that this stimulus acted best and with increased vigor when the two cultures were separated from each other by a quartz wall. This increased effect through quartz is explained on the grounds that since the metabolic products (especially the butyric acid) of the bacteria are not in actual contact with the yeast cells, they cannot exert their inhibitory influences on yeast growth and propagation; and, hence, the beneficial effect, meets with no contravening factors on its action upon the yeast cells. (See figure 14.) (*Rafael Arroyo.*)

The natural rum aroma. Our research work on the production of quality rums of various types led us to a study of the different factors contributing to the development of the characteristic natural aroma.

The great advantage in the development of a natural characteristic aroma in a given rum lies in the fact that once the objective is attained, the resulting bouquet of the individual rum in question will be almost impossible to imitate through artificial means. On the contrary, any artificially imported aroma will be easily found and imitated by competitors.

The aroma of a well matured, genuine rum is influenced by at least two groups of factors: (1) the aggregate of aromatic bodies originally existent in the raw distillate; (2) other aromatic bodies formed during the maturing process. Among this second group are included modifications suffered, in the shape of oxidations and condensations by some of the substances mentioned under (1).

The first group is by far the most important, as its nature will determine to a large extent the quality and quantity of those aromatic bodies formed under (2). So great is the influence of No. 1 group of factors that it may be stated that a poor raw distillate will never be transformed into a cured product of true worth and merit.

With the exception of the Rum Oil, the aromatic bodies of the first group are much better known than those of the second. This is due to the fact that many of the condensation and oxidation products formed during the maturing stage in oak barrels, are easily decomposed or degraded into simpler bodies with different aromas through the action of heat since existing analytical methods require the redistillation of the cured product previous to its analysis, only those bodies not susceptible to this decomposition or degradation will be found unaltered in the sample after passing through this distillation. Hence the analytical sample will never truly represent the rum from which it is taken.

The aggregate of aromatic bodies in group No. 1 is formed during the fermenting or the distilling stages, and is inherent to the raw distillate. A very small part may come unchanged from the raw material used for fermentation, but these are met only occasionally and in negligible amounts.

The formation of the aromatic bodies mentioned as group No. 2 are the result of a very complex process not entirely dilucidated as yet. Some are formed through modifications of some of those in group No. 1; others are the result of the influence of the chemical compounds extracted from the staves of the barrel itself, or to the interchanges of these extracted bodies with those already present in the raw rum. Catalytic agents encountered in the wood of the barrel; the oxygen of the air; the temperature and relative humidity of the surrounding atmosphere, are contributing factors in the formation of new aromatic bodies as well as in the modification of others already existing in the raw distillate.

The whole problem is very intricate and of a very complex nature. There is no question, but that further and careful study of the subject is very much needed. Analytical methods for the testing of matured rums, especially with the end in view of acquiring a better knowledge of their chemical constitution, should be revised and improved upon. (*Rafael Arroyo.*)

Rum types greatly modified through variations in fermentation technique. Creation of new types also possible. Much work was devoted during the last fiscal year in studying the modifications in the chemical composition as well as organoleptic character of rum types through the introduction of innovations or changes in either mashing or fermentation operations. The results obtained gave us the general impression that here lies a vast field of endeavor in scientific rum making. So far, the industry has contented itself with following the old accepted routine in mashing and fermentation methods, little realizing the great improvements and changes that may be achieved through systematic variations of technique.

Rums manufactured from sugar cane juice were given different treatments either during mashing or fermentation with the following results:

a. Rums resulting from the fermentation of raw fresh juice as obtained directly after milling, were faulty as to yields, bouquet and aging qualities. The time taken for acquiring maturity and mellowness was too long, and even then the quality was not of the first order.

b. Rums in which the raw cane juice was pasteurized at 80°C. for 10 minutes previous to mashing operations and final fermentation, were of much better quality than those from untreated cane juice; aged far more rapidly; and besides, the yields were from 8 to 10 percent greater.

c. Rums where the juice was defecated and clarified previous to mashing and fermentation, were of still higher quality as to taste and bouquet. Besides, their maturing properties were fully developed in a comparatively short aging period. Yields were about the same as in case (b) above.

d. Rums fermented at constant or nearly constant pH value during the entire fermenting period offered a raw product of great cleanliness of aroma; the aroma itself being of a very smooth and delicate nature.

The product ages very fast and the mature rum has mellowness, smoothness and delicacy of taste.

e. Symbiotic fermentations between yeast and certain "fungi imperfecti" gave rise to a really new type of rum quite different to any of the well known types in the market. It had a decided resemblance to fruit brandy and apple jack when matured. Highest yields were obtained.

As raw cane juice rums obtain a price nearly twice as high as those from final molasses in the local market, where they are greatly used as blenders, an effort was made to obtain a molasses rum possessing the characteristics of sugar cane juice rum Here again, we met with quite successful results, although at the expense of yield. More work is considered necessary along this line. Variations in fermentation technique were responsible for the results so far obtained. (*Rafael Arroyo, F. Marrero* and *L. Igaravídez.*)

Prospects on the establishment of cellulose industry in Puerto Rico look very favorable. The laboratory research work on the production of alpha-cellulose from sugar cane bagasse and foliage, which was discontinued during the fiscal year 1937–38 was continued in the semi-pilot plant under our technical supervision, and in cooperation with the laboratory of Agricultural Industries of the Department of Agriculture and Commerce.

The semi-pilot plant work thus far accomplished has established beyond all reasonable doubt that the production of cheap butyric acid from blackstrap molasses in a commercial way is entirely feasible. This is of great importance in the commercial development of our cellulose process, which is based on the use of butyric acid in the preparation and purification of the raw material.

Butyric acid of the strength and quality necessary for this work, can be produced at not over one cent per pound. This statement is based on: (1) present price of blackstrap, at an average of 2 cents a gallon; (2) fermentation efficiency of the process for the acid production, around 96.1 percent of the theoretically possible; (3) yields of acid of 47.00 percent on the weight of sugars in the molasses equivalent to 2.9 lbs. acid per gallon of molasses; (4) extreme simplicity of process. Actual work on the cellulose development will start soon. (*Rafael Arroyo* and *Víctor L. Quiñones.*)

Studies on the possibilities of industrial utilization of the coconut. A special study of oil plants is being made. Much emphasis is being placed on the utilization of coconut oil in various industrial enterprises.

Best methods of oil extraction from the standpoints of safety, ease of operation, yields, and quality of the resulting product were studied experimentally. A method was devised in which a combination of steam-cooking of the ground pulp with subsequent pressing or super-centrifuging is effected. The product thus obtained is clean, wholesome and of sweet odor, and will stand storage under proper conditions without detriment to quality, previous to the process of hydrogenation.

A considerable number of analyses were performed on the pulp; as well as determinations of relative yield of pulp, shell and husks per thousand coconuts treated. An important and interesting point in this connection is the fact that the shells and husks will easily provide for the fuel necessary to supply the steam demands of a factory dedicated to the manufacture of products from the pulp and juice of the fruit. (*José H. Ramírez.*)

Cassava bread. Experiments completed this year show that a good quality bread can be obtained from a blend of wheat and cassava flours.

In color the breads run from very white to highly colored, depending on the kind of cassava flour used in the mixture. Cassava bread has a very agreeable and characteristic flavor and aroma; and these become more distinct as the percentage of cassava flour increased in the blend. With 20 percent cassava flour a good loaf of bread is obtained by yeasting heavier than usually and adding nutrient salts in the form of potassium phosphate. Then a rapid fermentation of the dough is obtained which gives a good rise and a loaf with a good volume.

The process employed was the straight dough method in which all the ingredients of the dough are mixed together, after which it is allowed to rise (fermentation period), then divided, weighed, panned and baked. The total fermentation period for cassava and wheat flour blends should not extent much over four hours. A longer fermentation, no matter how conducted, will weaken the dough texture to such a degree that it will become very sensitive to shocks and to heat, and on placing it in the oven will contract to a very small volume and will not rise again. Besides, the "eyes" in the bread will lose uniformity of size.

The loss in weight on baking of the cassava and wheat flour blends, has been from 2 to 4 percent less than for straight wheat flour bread produced under the same conditions. Under our experimental conditions conditions wheat bread had a loss of about 13 percent, while for the blends with 20 percent cassava flour the loss on baking was only about 11 percent. (*H. E. Cruz Monclova.*)