

FOREIGN AND DOMESTIC RUM

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RUM is an alcoholic beverage distilled directly from fermented sugar cane products. In whisky manufacture several kinds of small cereal grains are utilized, and in brandy production many different varieties of fruit besides grapes are used; but rum has no source other than sugar cane. Rum is the original and most interesting form of beverage spirits because of the romantic part it has played in English and American history, although it ranks only third in quantity produced in the United States (2) among the distilled beverage liquors. Rum was originally made in Barbados and afterwards in the other West Indies, as early as the sixteenth century (9). Rum manufacture began rather early in the United States, and by 1783 there were no less than sixty distilleries fermenting molasses and dis-

tilling it into rum in Massachusetts. In 1791 over 7,000,000 gallons of molasses were imported into that state for the manufacture of rum (12).

Only four distilleries are producing rum in Massachusetts at present, and there are no other legitimate rum distilleries in New England. There are only four other registered rum distilleries in the rest of the United States, one in Pennsylvania, two in Louisiana, and one in Kentucky. During the fiscal year 1936, 2,699,572 gallons of molasses were used in the manufacture of beverage and denatured rum.

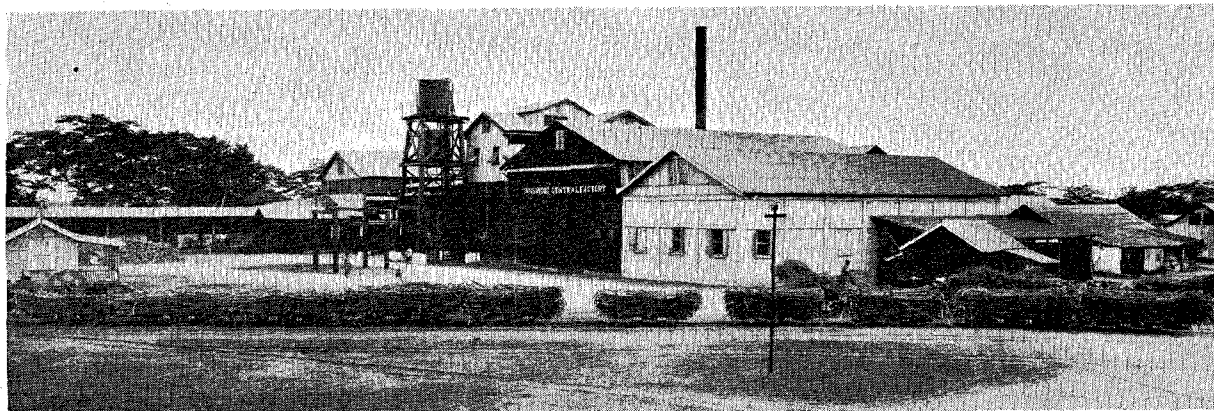
In June, 1937, there remained in United States bonded warehouses 3,178,107 gallons of rum as contrasted with over 445,000,000 gallons of whisky and 6,000,000 gallons of brandy (2).

The raw material used in the manufacture of rum ranges from fresh sugar cane juice through the various stages of partially to completely sugar-stripped molasses. Skimmings from the sugar kettles and other waste products of saccharine character from the sugar factories are utilized in the sugar-producing countries. However, in the United States only imported blackstrap molasses is used in the manufacture of rum.

The methods of rum fermentation vary considerably, ranging from spontaneous fermentation through the use of



RUM DISTILLERY AT
CHRISTIANSTED, ST.
CROIX, VIRGIN
ISLANDS



SUGAR FACTORY AND RUM DISTILLERY IN JAMAICA

baker's, brewer's, and winery yeast up to that of special pure-culture rum yeasts prepared from a single cell in some of the most scientifically controlled rum distilleries in the United States. The periods of fermentation vary from 2 to 12 days or longer, depending on the style of fermentation and the

Rum, essentially a sugar cane product, is distilled, casked, aged, and analyzed in the same manner as whisky. The congenics, flavor, and color are developed at about the same rate and in the same manner as in whisky. Taste and aroma are important factors in the ultimate judgment of rum. Whisky is commercially a more important liquor with English-speaking people and is generally more uniform in composition; rum is much more cosmopolitan, and its character and composition vary with the country producing it. Rum steadily improves in character with aging, either in charred or plain cooperage; often, after being matured, it becomes very valuable as a flavoring liquor.

custom of the country producing the rum. The initial mash in the rum distilleries of the United States usually has a pH from 5 to 7 before it is adjusted with dilute sulfuric acid to pH 4 or 4.5. In this country only pure-culture yeasts are employed, which are known to impart to rum a fine aroma and good flavor, and to produce a uniform product.

The stills used in rum distillation include crude forms of pot stills, pot stills with various modifications and rectifying devices, beer stills with doublers, chambered stills, and continuous rectifying stills. The proof of distilled rum varies from below 120° up to 190°, yielding products rich in congeneric substances to almost pure alcohol. The distillation processes are sometimes followed by redistillation, leachings through charcoal, and rectifying treatments other than distillation.

All rum that is distilled at a low proof in the United States is adjusted to approximately 100° proof and stored in United States bonded warehouses for aging. It is sometimes quick-aged with charred white oak chips before storage. On the other hand, rum distilled at a high proof is not intended for aging, or for very little aging, but is meant for early sale. This product has only small amounts of congeneric substance left, and very little change takes place during storage. This rum which is almost neutral spirits is often given a quick age treatment with chips and usually constitutes the light-bodied rum placed on the market to compete with the well-known brands of imported Cuban rums. Rum manufacturers in this country age all or part of their rum in United States bonded warehouses. Most of the rum manufactured in this country is aged in new, charred, white oak barrels for periods from a few months to 4 or more years. However, a small quantity is also stored in re-used and plain cooperage.

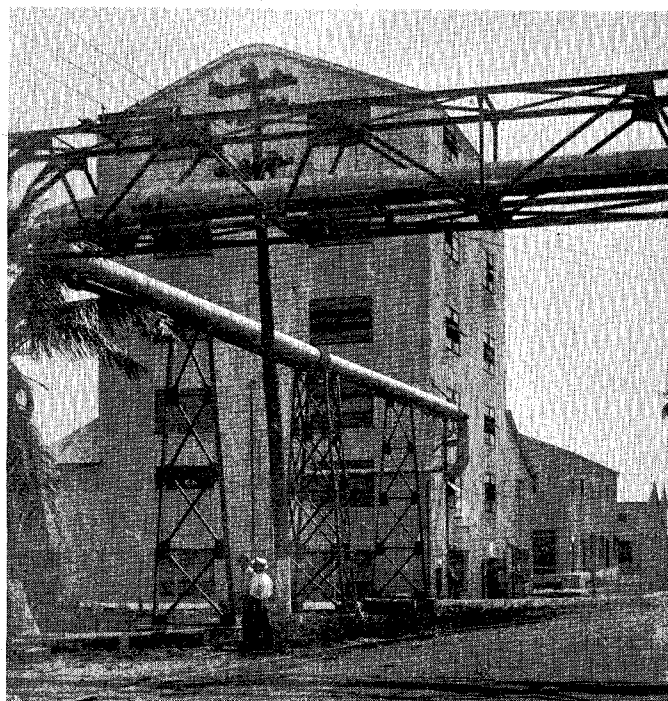
Although there is almost a quantitative conversion of the fermentable sugars into carbon dioxide and alcohol during the fermentation of the rum-producing materials, there is certain proof that a series of reactions is going on in which numerous intermediate products are formed and used up during the process. When ordinary molasses mash, which usually contains the necessary mineral salts and nitrogenous food for the yeast, ferments to produce principally carbon

dioxide and alcohol, a considerable number of other substances are present in the finished fermented mash. Some of these substances originate from the carbonaceous and others from the nitrogenous material of the molasses, owing to the metabolic action of the yeast cells. Among the products formed are fusel oil (alcohols higher than ethyl), acetic and other acids, ethyl and other acetates, and acetic and other aldehydes (5).

The most expensive raw material used to make rum is sugar cane juice, because of the valuable commercially available sucrose it contains. The cheapest material and the most extensively used for rum making is ordinary blackstrap molasses from which all of the extractable sugar has been taken that is commercially practical. Mixtures of both the above materials, including juice drippings, cane washings, skimmings, waste sugar, and slop (dunder) of previous distillations, are also employed.

It is possible for anyone with experience to distinguish by taste, rum made by fermenting cane juice and that made from blackstrap or finished molasses, provided the distillate is not too highly rectified by redistillation or by filtering through carbon or other rectifying processes. If the distilled rum contains some body consisting of a fair amount of acids, esters, fusel oil, and other congenics, the aftertreatment, such as aging in wood and other conditions, outweighs

any influence due to the original source of the material. It is necessary that clean cane products be used in any case. According to the statement of owners of most of the rum in New England prior to 1917 (very little is still on hand and is much sought after because of its excellent qualities for beverage and flavoring purposes), the rum was made from plain, inedible, imported blackstrap molasses. The care taken in its distilling, the long aging in charred barrels, and other phases of handling were principally responsible for its excellent quality.



STILL HOUSE WITH STEAM LINES IN THE FOREGROUND, PUERTO RICO

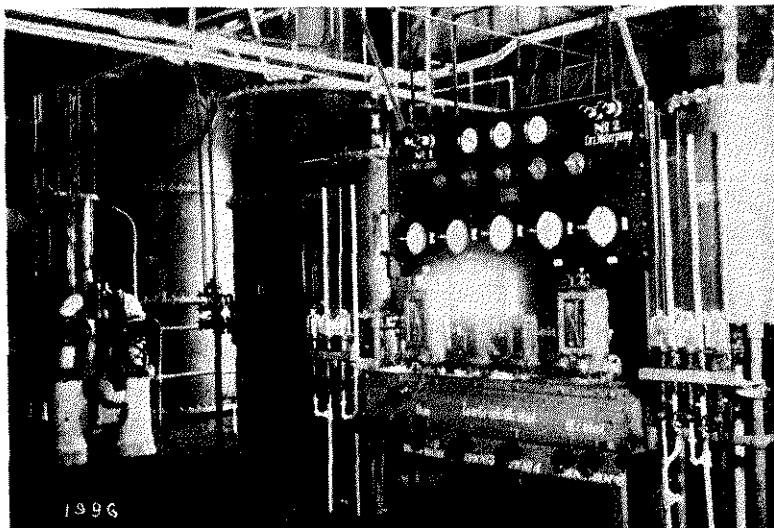
Purpose of the Investigation

The purpose of this investigation was to determine in general the chemical characteristics of rum and to distinguish it from other spirituous liquors. These chemical data are intended to furnish the means of distinguishing the difference between the products of the various foreign and domestic rum-producing countries in order to establish correct standards of identity. It is hoped that this information will enable the chemist to determine whether a rum has been rectified, adulterated, mislabeled, misbranded, falsified, or sophisticated in any way. Extensive articles (4, 11) have already dealt with whisky, but comparatively little research work has been published on rum. The most comprehensive discussion by Cousins and others in 1902 (8) dealt almost entirely with West Indian rum. On the whole, the existing chemical data available for the analyst concerning the composition of rum is scarce, rather old, and often, when applied to rum made at the present time, somewhat misleading. For instance, the principal emphasis was at one time placed on the ester content of rums, Jamaica rum in particular. It was expected that chemical analysis of authentic Jamaica rum would show several hundred grams of esters per 100 liters. It was even proposed by some leading rum authorities of the United Kingdom (9) that a minimum ester content be set at 200 grams per 100 liters of absolute alcohol. No

such rums are being sold at present, and it is doubtful if any such rums exist anywhere.

Cuba

Most of the rums analyzed from Cuba (6) had a characteristic taste that may be called fruity, or slightly like the taste of molasses, or a weak combination of both. The rum flavor in the usual Cuban product is weak; the fruity flavor (ethyl ester), while also weak, predominates. The acids, esters, in fact all of the congenetics of the Cuban rums are low. Chemically, these rums differ somewhat from whisky and are more like brandy in that their ester content, while low, is higher than their acid content, which probably ac-



CONTROL FLOOR OF A PUERTO RICO RUM DISTILLERY

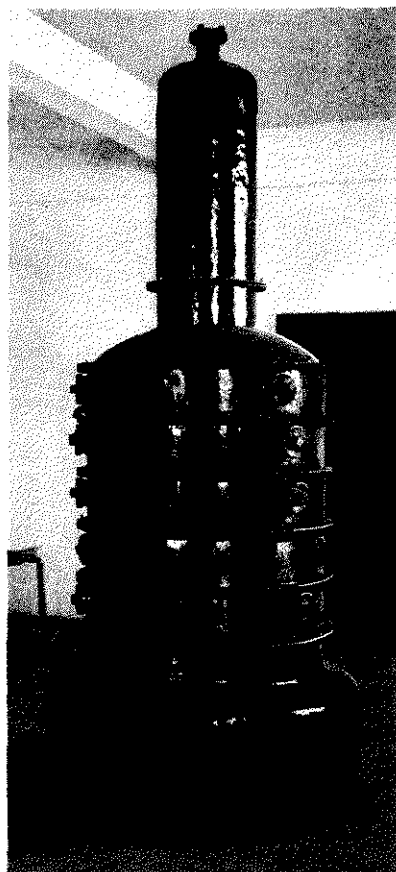
counts somewhat for their light brandy character. Practically every rum distiller in Cuba uses molasses entirely; he employs quick fermentation processes lasting on an average for 3 days and a special yeast culture, and distills in continuous stills at high proof (160° or over). Practically all of the distillates are leached through sand and charcoal filters, which tend to strip the distillate of rum congenetics and residual molasses or rumlike taste and odor. Uncharred or second-hand oak casks are used for storage. Except in the "white" Cuban rums, all the color is due to caramel. The Cuban rums usually have a high solids content, due to added materials such as sugars, bay leaves, wines, fruits, flavoring ingredients, and coloring matter. All the Cuban rum is either "white" or "gold" in color, and as a rule the color is uniform. The Cuban rums, all of which are light in body, consist of two general classes—the lighter variety is the Ron Carta type and the slightly heavier type is the Ron Oro.

The Cuban rums, particularly those of the Bacardi type, are so dissimilar in character to the New England type as to constitute almost a different kind of beverage spirits, although each has its origin in the distillation of fermented molasses. The Cuban rum is almost completely stripped of its congenetics by distillation at high proof and by other rectifying processes. From this point the rum is built up by added ingredients, which furnish most of the characteristic tastes and odors of the finished product. This rum receives and requires very little aging. The New England rum, on the other hand, is not distilled at so high a proof, and all of its character is obtained from the congenetics distilled from the fermented molasses and those subsequently developed in the changes taking place in the charred white oak barrels during storage.

Table I shows the analyses of the leading Cuban rums. Attention is called to the low congenetics and color, the esters (while low, they are more often higher than the acids), the usual high solids, and the below-medium fusel oil content.

Virgin Islands

Most of the rum produced in the Virgin Islands is made on the largest island (St. Croix) of the group, where its fertile lowland valleys furnish vast quantities of sugar cane. There are four rum distilleries on this island, and they use only sugar cane juice as the fermenting material. The cane is crushed, and the juice is hauled or pumped directly into the fermenters as soon as possible to avoid premature fermentation.



PORTION OF AN OLD SPANISH STILL USED IN PUERTO RICO ABOUT 1900

TABLE I. ANALYSES OF AUTHENTIC CUBAN RUMS

Lab. No.	Proof	pH	Grams per 100 Liters Not Calculated to Proof					Solids	Aldehydes	Furfural	Depth of Color in 0.5-Inch Cell	Title and Comments
			Total Acid (as Acetic)	Volatile Acid (as Acetic)	Esters (as Ethyl Acetate)	Fusel Oil (as Amyl Alcohol)	Fusel					
51,599	84.4	...	14.4	7.2	21.1	73.9	184	4.0	None	12.0; caramel, no age	Ron Carta Licars	
51,600	85.2	...	7.2	4.8	28.2	61.6	744	2.4	None	1.5; no artificial color	Ron Carta Extra Superior	
51,601	85.2	...	14.4	7.2	17.6	43.1	916	0.8	None	18.5; caramel, no age	Ron Superior	
51,602	87.6	...	2.4	2.4	19.4	44.9	714	3.2	None	1.5; no artificial color	Ron Superior Carta	
51,605	86.4	...	9.6	4.8	22.9	94.2	94	7.3	0.2	1.5; no artificial color	Ron Plus Ultra	
51,608	84.6	5.32	14.4	14.4	29.9	74.8	176	0.6	None	13; caramel, no age	Ron Obispo (1905) caramel; no age	
52,288	91.0	...	9.6	4.8	8.8	31.7	792	0.6	None	12; caramel, no age	Ron Rovira (Cordon Rojo)	
52,289	89.6	...	9.6	...	14.9	28.2	666	None	None	1.5; caramel, no age	Ron Rovira (Cordon Azul)	
52,290	88.6	...	16.8	9.6	13.2	45.8	918	1.9	None	13.0; caramel no age	Ron Anejo Vencedor (Rovira)	
53,543	87.6	...	24.0	21.6	20.2	58.1	76	None	None	1.5; no artificial color	Daiquiri, Coctelera (Cordon Blanca)	
53,544	88.4	5.57	21.6	7.2	12.3	61.6	1624	None	None	14.0; caramel no age	Daiquiri, Coctelera, Golden Cord	
52,979	88.2	...	21.6	...	19.4	29	710	None	None	20; caramel	Ron Bacardi Superior (Carta de oro)	
52,980	88.8	...	38.4	...	29.9	87.1	105	None	None	3; no artificial color, age	Ron Bacardi Superior (1873)	
52,981	89.6	...	7.2	4.8	17.6	37.8	430	None	None	1; no artificial color	Ron Bacardi Superior (Extra)	
53,147	88.6	5.82	4.8	4.8	11.4	58.1	40	0.4	0.4	1.0; no artificial color	Havana Straight; weak rum taste	
54,257	87.4	5.09	14.4	9.6	15.8	59.8	354	3.2	0.6	13; caramel	Havana Straight; gold; weak rum taste	
53,150	82.2	...	31.2	...	17.16	66.9	2208	4.8	None	7.5; caramel	Cuban	
36,039	87.3	5.03	13.2	12	11.4	49.3	678	1.6	0.1	14.5; caramel	Ron Bacardi Superior, gold; weak rum taste	
36,041	87.2	...	2.4	2.4	8.8	51.0	526	1.2	None	1.0; no artificial color	Ron Bacardi; weak rum taste	
60,129	89.2	5.58	9.6	8.4	7.9	25.5	502	6	0	1.5; no artificial color	Bacardi Superior, Carta Blanca; weak rum taste	
60,040	92.2	5.29	19.2	19.2	15.8	47.5	915	7.0	0	12; caramel, no age	Ron Anejo Vencedor; fair rum taste	
60,047	92.8	5.54	12	12.0	15.8	91.5	115	6.2	0	1; no artificial color	Ron Carta Plus Ultra; fair rum taste	
60,049	89.8	5.34	14.4	12.0	15.8	54.6	780	7.7	0	7; caramel, no age	Ron Carta Gallito; weak rum taste	
60,050	87.6	5.14	19.2	18.0	15.8	59.8	348	7.0	Trace	11; caramel, no age	Havana Club; weak rum taste	
60,054	87.0	5.57	27.0	21.6	19.4	47.5	545	5.5	0	3; caramel, no age	Daiquiri Coctelera (Blanca); weak rum taste	
60,057	93.6	5.53	12.0	12.0	17.6	29.9	725	4.6	0	5; caramel, no age	Ron Rovira, Cordon Rojo; weak rum taste	
78,432	88	4.62	60	49.2	29.9	65.1	956	7.7	0.32	16.5; caramel, some age	La Cabana (Havana); claims to be 15 years old	

Generally the mash is yeasted with a pure culture, but in some instances spontaneous fermentation is practiced with the fermenting periods extending up to 8 days. Distillation is carried on in both pot stills and continuous stills. The St. Croix distillers do not add any essences or neutral spirits to the rum, which is placed only in charred white oak barrels for maturing.

One distillery in St. Croix has produced over 500,000 gallons of rum during the past two years, which is more than the output of all the other Virgin Island distilleries. The rum from this distillery is made under scientific supervision so that the same conditions are present to yield a product that is always substantially of the same character (samples 77,464 and 77,652, Table II). The rum produced here is fermented by a pure yeast culture, and the mash is distilled in a 28-foot continuous-column still at a proof of 135° to 150°; the finished product, to which nothing is added, is matured in new charred white oak barrels.

St. Thomas, which has only about one-fourth the area of St. Croix, is the only other island of this group producing rum. Because of the small amount of agricultural land suitable for raising sugar cane, most of the raw material used by the two rum distilleries in St. Thomas must be brought from elsewhere. Molasses, cane juice, and cane sirup are the fermenting materials to which yeast is added to assist

the natural fermentation. Pot stills are used for the distillation of the mash, the distillate being about 130° proof. Coloring matter and fruit juices are sometimes added to the finished product which is matured in re-used, newly charred, or uncharred (plain) barrels, and occasionally in wine barrels.

The warehouses in the Virgin Islands are not heated, but a year-round temperature of 85° to 90° F. is maintained. Practically all of the rum produced in the Virgin Islands (about 500,000 gallons a year) is shipped to the United States, except what is consumed locally.

Puerto Rico

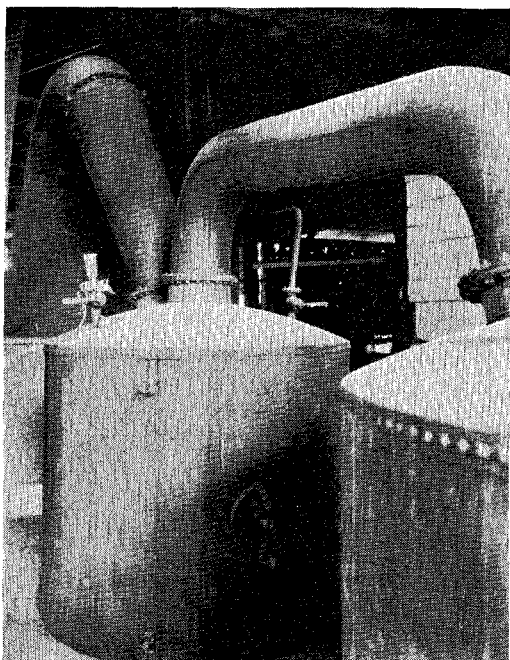
Up to January, 1935, there were no registered rum distilleries operating in Puerto Rico, although several concerns had applied for permits. The only kinds of rums produced were blends with alcohol and imitation rum. Jamaican, Martinique, and Cuban rums were mixed with neutral spirits, or neutral spirits were mixed with rum essence and other artificial flavors. In addition, they were often fortified with other foreign ingredients such as wine, sugar, molasses, prune and other fruit juices, and were artificially colored with caramel.

Group 1, Table III, shows the analyses of Puerto Rican rums which are considered authentic only in that they were blended and rectified on the island. All samples in the first

TABLE II. ANALYSES OF AUTHENTIC VIRGIN ISLAND RUMS

Lab. No. ^a	Proof	pH	Grams per 100 Liters					Solids	Aldehydes	Furfural	Color in 0.5-Inch Cell	Title and Comments
			Total acids	Volatile acids	Esters	Fusel oil	Fusel					
51,603	89	4.88	33.6	33.6	65.1	55.4	82	5.6	0.8	7; no artificial color	St. Croix; good rum taste, cane juice	
52,563	90.6	4.47	96	88.8	67.8	61.7	130	12	1.2	5; no artificial color	St. Croix; good rum taste	
60,073	89.6	4.88	36	33.6	61.6	56.3	95	8.8	0.6	6; no artificial color	St. Croix; aged rum taste, cane juice	
77,464	92.8	8.05	4.8	2.4	44.0	59.8	205	7.0	0.8	15.5; no artificial color	St. Croix; aged rum taste, cane juice, 2 years old, aged in new, heavily charred barrel	
77,652	91.2	7.62	9.6	2.4	43.1	58.1	178	7.5	0.6	14.0; no artificial color	St. Croix; aged rum taste, cane juice, 1.75 years old, aged in new, heavily charred barrel	
51,604	91.2	...	24	16.8	24.6	80.1	578	7.3	0.2	21; caramel ^b	St. Thomas; good rum taste	
60,041	93.2	...	26.4	24.0	28.2	73.9	580	14.3	0.4	19; caramel ^b	St. Thomas; good rum taste	
69,332	95.6	5.72	43.2	24	29.9	24.6	650	16.0	0	11; caramel ^b	St. Thomas; rum taste, contains neutral spirits and other added ingredients	
69,445	91.8	4.54	69.6	57.2	57.2	17.6	156	16.0	0	4.5; caramel ^b	St. Thomas; rum taste, contains neutral spirits	
76,462	106.4	6.48	21.6	8.4	11.4	21.2	1098	2.4	0.4	22.5; caramel ^b	St. Thomas; rum taste, contains neutral spirits and added solid ingredients	

^a Samples 51,604, 76,462, 69,332, and 60,041 contain added solid ingredients and coloring matter, and hence would be classed in U. S. as rectified products. Samples 77,464 and 77,652 are abnormally low in acids for 1.5-year-old rum; the alkali extracted from the heavily charred surface probably neutralized some of the acids formed. ^b Artificially colored with caramel.



GOOSENECK STILL AND RETORTS IN A JAMAICA RUM DISTILLERY

group are blends and imitations and are the rums made in the manner just described. The rums of a higher laboratory number (group 2, Table III) are distilled and represent the product of every rum distillery operating at present in Puerto Rico.

In most instances group 1 shows a high artificial solids content and a fusel oil content almost as low as that of rectified spirit.

Samples 53,594 and 53,101 were purchased in Washington as Puerto Rican rum and consisted of neutral spirits fortified with a rum distillate and caramel. Their source was traced to Puerto Rico.

Group 2 represents a new era in rum production in Puerto Rico. It includes the new permittees (since repeal) who are distilling rum at 140° to 165° proof and below, and also some few who may distill rum up to 180° proof.

The materials fermented by the rum distillers are pure cane juice, first molasses, and blackstrap (final molasses). Fermentation of blackstrap molasses mash, however, is the rule, usually with the addition of ammonium sulfate for yeast food, and in some cases with sulfuric acid added to inhibit bacterial growth. The time of fermentation is variable, but usually the mash is allowed to stand for 4 to 7 days before distillation. It is claimed that this process gives rums of a relatively light flavor, rather low in congeneric substances. At present a large quantity of the rum of the composition shown in group 2 is being shipped to the United States. It is nec-

TABLE III. ANALYSES OF AUTHENTIC PUERTO RICAN RUMS

Lab. No.	Proof	pH	Grams per 100 Liters					Not Calculated to Proof		Aldehydes	Furfural	Color in 0.5-Inch Cell	Title and Comments
			Total acid	Volatile acid	Esters	Fusel oil	Solids						
Group 1													
56,252	88.4 ^a	4.88	24	14.4	14.1	4.9	1096	0	0	7.5; caramel, slight age	Ron El Cuco (Santurce); weak rum taste and odor		
56,254	92.2 ^a	...	100.8	...	28.2	9.2	1485	0	0	2.0; caramel	Ron China (Mayaguez); weak rum taste		
56,255	91.8 ^a	...	18	7.2	66.9	5.6	415	0	0	4.0; caramel	Ron Superior Oro Viejo (Mayaguez); weak rum taste		
56,256	99.2 ^a	...	30	2.4	42.2	10	2325	0	0	Colorless	Ron Blanco (Mayaguez); weak rum taste		
56,257	94.4	...	4.8	4.8	49.3	5.6	195	0	0	6; caramel	Ron Gilet (Ponce); weak rum taste		
56,258	90	5.39	19.2	7.2	14.1	13.7	470	0	0	10; caramel	Ron de Medalla de Oro; weak rum taste		
56,259	90.8	...	19.2	12	14.1	4.2	390	0	0	4.5; caramel	Ron Brande (Santurce); weak rum taste		
56,260	88.8	...	38.4	...	22.9	7	552	0	0	8.5; caramel	Ron Superior (Mayaguez)		
56,261	91.6	...	14.4	7.2	21.1	4.4	225	0	0	4.5; caramel	Ron Superior Patria y Cuna (Mayaguez)		
56,262	90.8 ^a	...	60	40.8	33.4	20	1174	0	0	17; caramel	Bulls-Eye (San Juan); fair rum taste		
56,263	92.8 ^a	4.56	69.2	38.4	35.2	9	1124	0	0	17; caramel, some age color	Ron Venerable (taste of age)		
56,264	91.5 ^a	...	33.6	14.4	19.4	7	722	0	0	34; caramel	Ron Marco Viejo; weak rum taste		
56,560	95.4 ^a	...	19.2	14.4	9.7	5.8	498	1.4	0	7.5; slight age, caramel	Ron Piza (Arecibo); weak rum taste		
56,561	90.2	...	24.0	2.4	14.9	7	288	3.6	0	11; caramel	Ron Emperador (San Juan); weak rum taste		
56,562	92.4 ^a	...	62.4	43.2	17.6	8	806	3.2	0.9	14; caramel	Ron Bueno Superior (Ponce); weak rum taste		
57,055	88.2 ^a	...	38.4	21.6	17.6	10.6	1165	2	0	10; caramel	Ron Kofresi (Ponce); weak rum taste		
57,056	92.6 ^a	...	26.4	12	8.8	11.8	1888	0	0	7; caramel	Ron Superior XXX (Ponce); weak rum taste		
53,101	87.6	5.38	7.2	4.8	9.7	22.9	76	0	0	7	Ron Toreador (San Juan); weak rum taste		
53,594	87.8	...	6	2.4	7.92	19.4	78	0	0	7; caramel	Ron Toreador (San Juan); weak rum taste		
60,046	88.4	4.27	36	20.4	14.1	79.2	740	6.0	0	13; caramel	Ron Viegolo (Ponce)		
60,060	98.6	...	48.0	48.0	59.8	117.0	450	20.0	4.0	23; caramel	Ron Superior (Mayaguez); fair rum taste		
60,062	78.8	...	3.6	3.6	3.5	7.0	72	2.0	0	3.5; caramel	Ron Defensa (Caguas)		
60,065	88.6	...	4.8	3.6	3.5	7.0	66	3.0	0	4.5; caramel	Ron Metralia (Caguas)		
60,066	88.8	...	21.6	18.0	10.6	7.0	234	4.0	0	12; caramel	Ron Hacienda (Caguas)		
60,067	89.3 ^a	4.82	24	18.0	9.7	14.1	1112	4.0	Trace	7; caramel	Ron El Cuco (Santurce)		
60,072	84.2 ^a	4.62	64.8	48.0	26.4	21.1	1156	10.0	0.80	18.5; caramel	Bulls-Eye (San Juan)		
Group 2													
65,832	90 ^a	5.07	21.6	21.6	26.4	109.1	1158.4	13.9	0.48	2; caramel	Arecibo (white label); from molasses		
65,926	90.7 ^a	4.73	26.4	24.0	29.0	135.5	1308	14.3	0.4	11; all caramel	Arecibo (gold label); from molasses		
65,446	82.5 ^a	5.24	12.0	9.6	33.4	44.0	1920.4	6.5	0	1.0	Carta Blanca (San Juan); distd. from cane juice, 7 mo. in wood		
65,447	93.8	6.07	2.4	2.4	48.4	35.2	34.4	2.5	0	0	San Juan; distd. from sugar cane juice, new		
65,448 ^c	90.1 ^a	5.03	26.4	24.0	29.9	112.6	1031.6	16.7	0.32	0	Arecibo; from blackstrap, dist. processed, ^b new		
65,449 ^c	163.5	5.82	7.2	7.2	25.5	165.4	11.2	6.0	0.16	0	Arecibo; from blackstrap, new		
65,450 ^c	142.6	5.5	21.6	19.2	34.3	137.3	9.2	11.6	0.40	0	Caguas; from first-class molasses mash, new		
65,451 ^c	133.2	5.5	21.6	21.6	33.4	119.7	14.4	2.5	0.24	0	Caguas; from first-class molasses		
65,452 ^c	149.7	5.28	43.2	43.2	23.8	109.1	60.0	5.1	3.2	2.5	Ponce; molasses dist. aged in white oak barrels		
65,453 ^c	148.8	6.0	7.2	7.2	26.4	169.0	10.4	2.2	0.8	0	Ponce; molasses dist. newly distilled		
65,454 ^c	96.9	4.46	45.6	38.4	34.3	91.5	475.2	7.8	0.4	4.5	Playa de Ponce; sugar cane juice dist.		
65,455 ^c	99.1	6.78	2.4	2.4	22.9	91.5	17.6	6.6	Trace	0	Caguas; from first-class molasses		
65,456 ^c	155.6	5.53	7.2	7.2	58.1	116.6	4.0	7.6	0.16	0	Caguas; from first-class molasses		
65,457 ^c	154.5	5.50	7.2	7.2	59.0	119.7	4.0	8.8	Trace	0	Caguas; from first-class molasses		
78,396	90 ^a	5.0	16.8	13.2	13.2	80.9	702	4.3	0	9.5	Ponce; large quantities shipped to U.S., called "rectified"		

^a Distilled.^b This distillate was treated with potassium permanganate and hydrogen peroxide.^c New.

TABLE IV. ANALYSES OF AUTHENTIC JAMAICA RUMS

Lab. No.	Proof	pH	Grams per 100 Liters Not Calculated to Proof							Color in 0.5-Inch Cell	Title and Comments
			Total acid	Volatile acid	Esters	Fusel oil	Solids	Aldehydes	Furfural		
55,291	98.4	...	36	24	63.3	99.3	260	16	1.6	10; caramel and age color	Finest Old Jamaica Rum (Kingston); strong rum taste and odor, claims 10-year age
55,292	99.8	...	76.8	60	95	99.8	880	14.4	2.8	72; heavy caramel and age color	Jamaica, Bottled in Bond (Kingston); strong rum taste and odor, claims 8-year age
53,149	90.4	...	48	...	75.7	88	478	6.4	2.4	36; heavy caramel	Coruba (Kingston)
54,380	90.6	...	48	38.4	105.6	62.5	316	0	1	10; caramel and age color	Jamaica, bottled in England; strong rum taste, claims highest quality
54,381	86	...	38.4	28.8	82.7	66.5	290	0	0.6	11; caramel, slight age	Jamaica; aged rum flavor
54,382	87.2	...	43.6	31.2	61.6	95	482	2.4	1.2	24; caramel, some age	Old Jamaica; aged rum flavor and taste, claims 8-year age
54,383	98.4	...	45.6	31.2	63.6	107.4	438	4	1	23; caramel, some age	Jamaica (Kingston); aged rum taste and odor
60,042	98.6	3.85	88.8	50.4	89.8	89.76	884	20.0	5.0	54; heavy caramel, some age	Bottled in Bond (Kingston); strong rum taste and odor, claims 8-year age
60,044	86	4.44	52.8	48.0	64.5	70.4	305	Trace	1.6	13.0; caramel, some age	Jamaica, bottled in England; strong rum taste and odor
60,060	98.6	4.17	57.6	48.0	59.8	91.52	450	20.0	4.0	23; caramel, slight age	Jamaica; strong rum taste and odor, claims 15-year age
60,061	98.2	...	57.6	48.0	59.8	84.48	492	18.0	4.0	24.0; caramel, slight age	Old Jamaica; strong rum taste and odor, distd. in 1926
60,069	90.4	4.62	55.2	48.0	93.8	62.5	325	0	3.2	10.0; caramel, slight age	Bottled in England; strong rum taste and odor

essarily new but is steadily improving in age and quality. In some cases quick-aging processes are employed to remove the newness and give to rum special character and color. Sample 65,448 was aged in a white oak barrel and there treated with calcium permanganate and hydrogen peroxide, diluted to 90° proof, and sold as genuine distilled rum. Sample 65,449 is the same rum, just as it was distilled at 163° proof but before any treatment had taken place. In one process, used rum is given a prolonged treatment with calcium permanganate at a rather high temperature in oak barrels, followed by precipitation of any dissolved calcium with sulfuric acid. Samples 65,452 and 65,453 were produced by a different distillery.

Puerto Rico ranks next to the United States in rum production. In 1936 the United States imported from Puerto Rico 124,286 cases of bottled rum (2.4 gallons per case), and during January to April, 1937, 106,929 cases were imported. In general terms, Puerto Rico now (July, 1937) exports to the United States more rum than does Cuba, which occupies second place as a source of "off-shore" rum. Jamaica is probably third, with the Virgin Islands fourth, and all of the other rum-producing islands together a poor fifth. Twenty-three rectifiers now blend and rectify rum of the composition shown in group 1, and nine distillers produce rum of the composition shown in group 2.

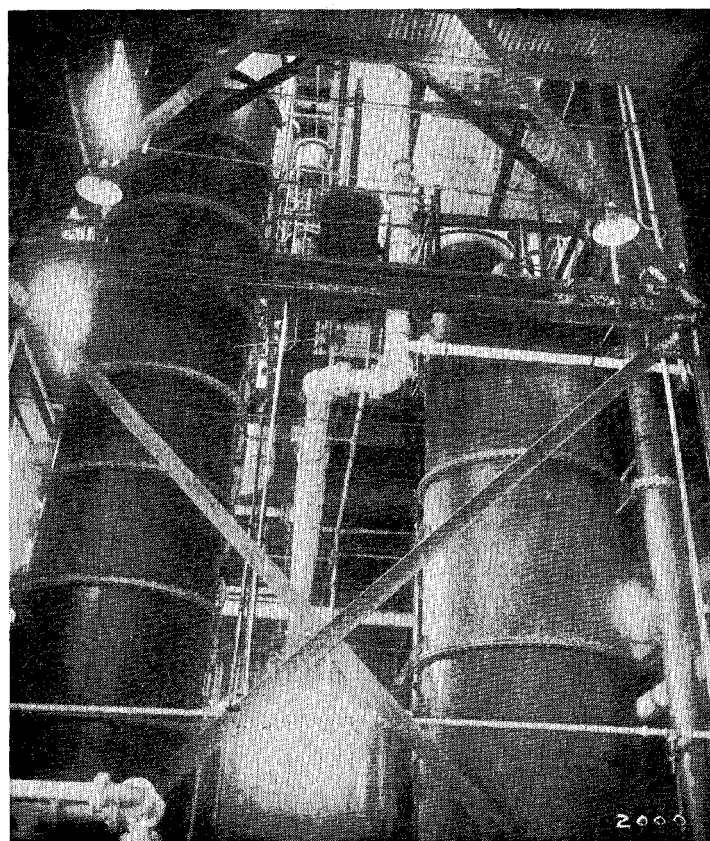
Jamaica

Jamaica was the earliest commercial producer of rum, and the largest stocks of the world's oldest rum may be found there (?).

Jamaica rum is the by-product of thirty-six sugar estates, each producing its characteristic product. The molasses from the estates is passed on to the rum distillery which is operated by each estate and is fermented in the following manner: The yeast culture is produced by using cane juice, molasses, dunder (previously distilled slop), and water sweetened to a low density. The mixture remains about 18 hours to permit desired fermentation, then further quantities of the same ingredients are added and placed in fermenting vats for 2 to 4 days. This "wash" is then distilled in a steam- or fire-heated pot still. Steam is passed through the coils of the still and wash boils so that vapor rises and flows down the gooseneck to the retort which has been previously charged with spirits of high strength. There the vapor mingles with the spirits, rises again, and passes to the condenser tubes around which a continuous flow of water trickles. The vapor is thus converted to liquid rum which is run off into vats placed in government-supervised warehouses on

the estates, later to be drawn off into charred or uncharred white oak puncheons with a capacity of 110 Imperial gallons, colored with burnt sugar caramel, and finally removed from the sugar estate to government warehouses to age. Jamaica rums may not be distilled over 166° proof (United States) and are produced from a mixture of sugar cane juice and molasses; each distiller uses his own particular proportions. A ton of sugar cane will yield approximately 100 pounds of raw sugar and 3 gallons of rum.

Over 100 years ago Jamaica rum was divided into three general types, and today it is still broadly divided into high-ester rum, medium rum, and good ordinary rum. The first class is sent to Europe to be used in blending with neutral spirits; the third class, which is least important, is consumed



DISTILLATION COLUMNS IN A PUERTO RICO RUM DISTILLERY

TABLE V. ANALYSES OF AUTHENTIC DEMERARA RUMS

Lab. No.	Proof	pH	Grams per 100 Liters Not Calculated to Proof							Color in 0.5-Inch Cell	Title and Comments
			Total acid	Volatile acid	Esters	Fusel oil	Solids	Aldehydes	Furfural		
55,287	101.6 ^a	...	122.4	67.2	24.6	36.1	3046	1.2	0	15.5; caramel	Fruit-cured, like brandy; weak taste and odor of rum, distd. in 1930
55,288	163.4 ^b	...	7.2	4.8	17.6	99.6	34	0.8	0	3; no artificial color	Weak rum taste and odor, slight brandy character; claims unblended
55,289	92.2 ^a	4.47	69.6	45.0	21.1	60	2078	1.6	0	14; caramel	Georgetown Demerara; weak rum taste, claims distd. in 1929
55,290	161.2 ^b	6.45	12	12.0	17.6	28.2	68	6.4	0	6.5; no artificial color	Georgetown Demerara; weak rum taste and odor
55,293	91.8 ^a	4.82	40.8	36	26.4	74.4	1214	1.2	0	16.5; caramel	Fair taste and odor of rum
55,294	90.2 ^a	...	48.0	24	19.4	58.4	1458	0.8	0	39; caramel	Weak taste and odor of rum
55,295	92.8 ^a	4.32	62.4	43.2	26.4	68.6	1510	0.8	0	34; caramel	Demerara; weak taste and odor of rum, claims matured and blended
54,379	150.1 ^a	...	57.6	36	51	89.8	544	0	0.4	68; heavy caramel	High-proof Demerara; weak rum taste
60,053	96.1 ^a	4.15	90.0	43.0	23.76	51.04	2470	7.0	None	17.0; caramel	Weak rum taste, claims blended
60,056	95.8 ^a	4.13	55.2	33.6	21.12	66.88	1408	7.0	None	37.0; caramel	Weak rum taste, claims blended
60,058	162.4 ^b	5.0	12.0	10.8	15.84	68.64	52	6.0	None	5.0; no artificial color	Straight high-proof; weak rum taste
60,059	121.4 ^a	4.25	57.6	28.8	36.9	80.96	870	12.4	Trace	46.0; caramel	Blended in England; weak rum taste
60,070	101.6 ^a	4.2	120.0	72.0	24.6	19.36	3046	1.2	0	15.5; caramel	Fruit-cured; weak rum taste
60,068	90.2 ^b	...	60.0	31.2	19.4	67.0	1470	17.6	0	40.0; caramel	Weak rum taste, claims blended

^a Distilled. ^b Straight.

locally. The medium rum is shipped to the United States and to most of the other markets of the world. The analyses of this rum are given in Table IV.

The essential difference between the three types of Jamaica rums lies in the kind of fermentation; the rums under each type vary mainly with the particular technic of the distiller, for rum distillation in Jamaica is still more of an art than a science. The production of Jamaica rum has increased steadily; 766,023 gallons were produced in 1934, 822,954 gallons in 1935, and 949,764 gallons in 1936.

Jamaica rum is, on the whole, richer in congeners than that from the other islands. The ester content is comparatively high, usually exceeding the acid content by a large margin. However, the body of Jamaica rum is not actually as heavy as the New England product. The acidity of the mash or wash is usually higher in the Jamaica fermentations than elsewhere, and this tends to produce a higher ester content. In the production of the so-called high-ester rums the acidity of the wash may be up to 3 per cent, the time of fermentation up to 29 days. The esters of rum are about 97 per cent ethyl acetate, about 2 per cent butyric ester, and 1 per cent esters of the higher molecular weight acids; the latter furnish the more aromatic character to rum. Ethyl acetate supplies only a fruity taste and odor.

The regulations governing the storage and bottling of rum in Jamaica are specific and rigidly enforced. The only ingredients that may be added to rums stored and bottled under Jamaican government supervision are pure water and burnt sugar caramel. The addition of essences and the practice of synthetic aging are not permitted.

The minimum bonding period for rum to be consumed in England is 3 years and in Ireland and New Zealand, 5 years. Australia requires a 5-year certificate if rum is to be labeled "old," and if labeled "very old," a 10-year certificate. Rums in storage in Jamaica range from new to more than 40 years

old. There is at least one bottle over 192 years old in this land of well-aged rum.

Demerara

Practically all the rum produced in Demerara (6) is distilled from fermented molasses which is the mother liquor obtained from the final recovery of Demerara sugar and which contains about 60 per cent of uncrystallizable sucrose and invert sugar. This molasses is reduced with water to a specific gravity of about 1.065, and 1 pint of sulfuric acid and 1 pound of ammonium sulfate per 100 Imperial gallons are added to the mixture. The sulfuric acid is used to reduce the bacterial infection in the so-called fermenting wash and to assist the yeast in the inversion of the sucrose. The ammonium sulfate is added to

furnish more abundant yeast food in order to speed the fermentation. The wash is rather low in density and is usually fermented out in less than 48 hours; it rarely contains over 6 per cent alcohol by volume. This fermented material is now distilled from 140° to 165° proof (sometimes higher). Both modified pot stills and continuous rectifying stills are in use in Demerara.

This high-proof distillate is generally sold and shipped in bulk at such proof to rectifiers and compounders for blending. Examples of this type of rum are samples 55,288, 55,290, and 60,058 (Table V). To the distillate of 140° to 168° proof are added French plums, Valencia raisins, spices, and other flavoring ingredients. This blend is allowed to set 24 hours, and then water and coloring matter are added. The mixture is again given a rest period of 3 or 4 days, and then isinglass and milk are added. The rum is now ready for aging which may be from a few months up to 3 years.

In Demerara some of the rum producers have a unique custom of placing chunks of raw meat in the casks to assist in aging, to absorb certain impurities, and to add a certain distinctive character.

The finished rums from Demerara usually have a charac-

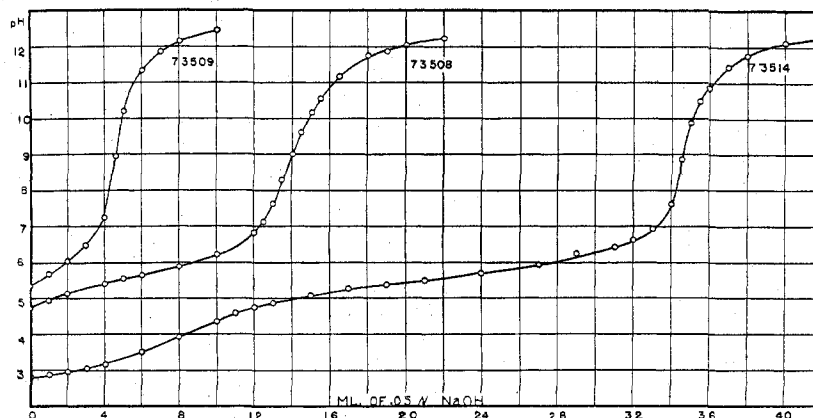


FIGURE 1. TITRATION CHART OF URUGUAYAN RUM (TABLE VII)

teristic fruit taste and aroma, the actual rum taste being rather weak. Most of these rums are highly colored with caramel which also has some influence on their flavor. Table V represents the analyses of the principal Demerara rums at present being imported into the United States.

Barbados

Rum made in the Island of Barbados (6) is somewhat similar to other rums made in the West Indies in that it consists of mixtures of molasses spirit which were originally distilled at approximately 185° to 190° proof and to which were added ingredients to produce desired types of flavors. The molasses spirits are usually distilled with lime and soda, often in the presence of vegetable roots, coconut shells, and other substances. The once crude rectifying column employed in Barbados is giving way to more modern column stills for the original distillation and redistillation. The few pot stills being used have been equipped with additional rectifying columns. There is a tendency to remove as much as possible of the original character due to fermentation of cane products and substitute a new character with added ingredients. The analysis of true Barbados rum is not shown, but a formula of well-known brands consists of a mixture of distilled molasses spirit varying in proof from 145° to 190°, sherry, Madeira or other wines, often spirits of niter, bitter almonds, and raisins.

Uruguay

Table VI gives the analysis of typical rums from Uruguay. Samples 73,508 and 73,509 are finished rums ready for the

market; samples 73,511 to 73,514 are raw, colorless, molasses distillates ready to be treated and aged into finished rum. Sample 73,514 has a high acid content; the 31.6-gram fixed acid content is sulfuric and was added to the distillate, presumably to catalyze the formation of esters. The comparatively high solids content of sample 73,513 is due to sodium sulfate. The fixed acid sample 73,511 is also sulfuric. All of the rums have the characteristic rum taste; although not strong it is unmistakable, and the rums would be classed as medium-bodied rum. Figure 1 shows the curves plotted from the potentiometric titration of the finished rums, and the effects of small amounts of the highly ionized sulfuric acid (10). The initial pH of sample 73,514 was so low that a highly ionized foreign acid was probably present. Further analysis showed that all of the nonvolatile acid was sulfuric.

Mexico

Comparatively little rum is produced in Mexico. Most of the rum made there is fermented from sugar cane juice, is very light-bodied, and has no particular character except that of neutral spirits. It is either distilled at a very high proof, or redistilled and rectified until only traces of rum congeners remain in the product, and there is very little characteristic rum odor or taste. Sample 73,537, Table VII, is a typical Mexican rum from Tabasco. Sample 58,314, Table VIII, was smuggled from Mexico into the United States labeled "Jamaican rum." It is a poor imitation consisting of neutral spirits with an artificial color and flavor.

TABLE VI. ANALYSES OF RUM SAMPLES FROM MONTEVIDEO, URUGUAY

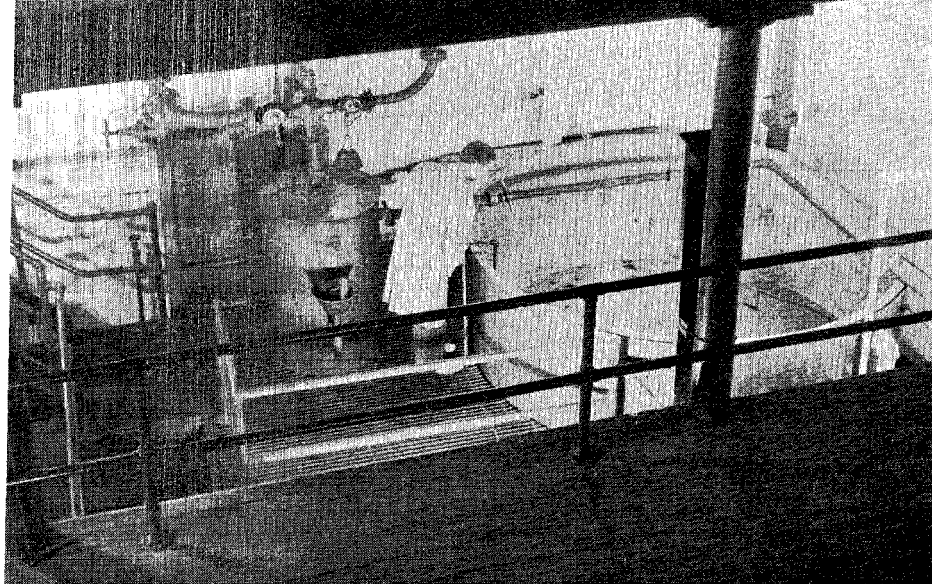
Lab. No.	Proof	pH	Grams per 100 Liters							Color in 0.5-Inch Cell	Title and Comments
			Total acid	Volatile acid	Esters	Solids	Fusel oil	Aldehydes	Furfural		
73,508	100	4.72	43.2	31.2	21.1	266	61.6	6.8	1.2	8; caramel and wood color	Cana Aneja de La Ancap; aged in wood, medium-bodied
73,509	100	5.34	16.8	16.8	9.7	254	33.4	7.2	0.4	3.5; all caramel	Cana de La Ancap; not aged in wood, light-bodied
73,510	90	8.38	2.4	2.4	55.4	16	45.8	16	Trace	Colorless	Grappa (a grape source); new highly rectified brandy, not aged
73,511	120	6.57	16.8	8.4	22.9	42	105.6	14.4	Trace	Colorless	Distillado A (from molasses); like rum dist.
73,512	118	4.22	67.2	67.2	15.8	14	73.9	4.8	0	Colorless	Distillado B (from molasses); like rum dist.
73,513	108	7.95	2.4	2.4	21.1	140 (sulfates)	65.1	40	0	Colorless	Distillado C (from molasses); like rum dist.
73,514	105	2.8	100.8	68.4	67.8	46	84.5	52	0	Colorless	Distillado D (from molasses); like rum dist.

TABLE VII. ANALYSES OF OTHER FOREIGN RUMS

Lab. No.	Proof	Grams per 100 Liters Not Calculated to Proof							Color 0.5-Inch Cell	Title and Comments
		Total acid	Volatile acids	Esters	Fusel oil	Solids	Aldehydes	Furfural		
45,594	82.7	21.6	19.2	33.4	44.9	352	0	0	6; artificial color	Ron Orinoco (Venezuela); very weak rum taste
51,607	89.8	33	30	21.6	74.8	118	1.3	0.2	8; no artificial color	Rum Sarthe (Au-du-Prince) (Haiti); rum taste, claims 5-year age
52,982	85.4	52.8	...	47.5	59.0	400	0	0	38; heavy caramel	Rum Negrita (French Indies)
44,520	73.4	14.4	14.4	31.7	18.5	1735	0	0	34; heavy caramel	Filipino rum; artificial flavor
73,537	77.2	4.8	4.8	7.0	0	254	0	0	7.5; all caramel	Mexican rum (Tabasco); odor and taste like neutral spirits
74,647	95.8	.24	21.6	14.9	33.4	54	3.2	0	Colorless	Portugal (Lisbon); from cane juice, very weak rum taste, pH 5.28
78,273	94.1	161	15.6	24.7	5.3	1150	2.5	0	20; all caramel	Filipino rum (Manila); reported as rectified, neutral spirits

TABLE VIII. TYPICAL IMITATION RUMS

Lab. No.	Proof	Grams per 100 Liters Not Calculated to Proof							Color in 0.5-Inch Cell	Comments, Claim, or Label
		Total acids	Volatile acid	Esters	Fusel oil	Solids	Aldehydes	Furfural		
53,790	84.9	81.6	...	63.4	136	1490 (added)	0	1.4	54; all caramel	Straight rum dist. with 2% artificial rum blends; Jamaica type rum
50,379	92.9	9.6	9.6	35.2	20.2	1934 (added)	0	0	45; all caramel	Neutral spirit base, added artificial flavor; straight distilled rum
58,314	81.2	4.8	2.4	10.6	7.0	222	1	0	15; all caramel	Neutral spirits, artificial flavor; smuggled from Mexico
74,921	86.6	60	60	220 (artificial)	7.0	1900 (added)	7	0	37; all caramel	Neutral spirits, artificial flavor; pH 3.72 rum
65,553	89	89	9.6	9.6	19.4	476 (added)	4	0	3.5; chips (indicated)	Oak-chip-treated, highly rectified rum;
51,248	97.8	50.4	...	63.4	6.2	2120 (added)	0	0	84; all caramel	Neutral spirits, artificial flavor, Jamaica type rum
52,417	94.3	9.6	...	23.8	28.7	1248 (added)	0	0	8; all caramel	Some whole rum with neutral spirits, artificial flavor; Cuban type rum
54,174	99.9	7.2	2.4	31.7	10.7	1010 (added)	0	0	6; all caramel	Neutral spirits, artificial flavor; Cuban type rum
54,175	97.7	48	38	96.8	68.6	1582 (added)	9.6	0.8	92; mostly caramel	Rum artificially flavored and very heavily colored; Jamaica type



VIEW IN A MASSACHUSETTS
RUM DISTILLERY

taste and odor are some of the important factors. Samples of typical imitation rums are given in Table VIII.

Old New England Rum

About three million gallons of beverage rum were made in Massachusetts in 1917, the last legal rum to be made until after the repeal of the Eighteenth Amendment (1933). It was known principally as Chapin rum or as Everett rum, and was made with ordinary blackstrap molasses, distilled in pot stills, and stored in new charred and in re-used barrels. During its long aging this rum developed such an excellent bouquet that it was much sought after and commanded the highest price. It was used principally for blending and flavoring purposes, and on account of the rich character

developed it formed the basis for the opinion of many that rum may improve steadily in quality after aging up to 20 years.

The analyses of two portions of this rum, which had aged in re-used barrels for approximately 19 years, are shown in Table IX.

Other Rum-Producing Islands

In discussing the production of rum in Trinidad, Grenada, Antigua, British Virgin Islands, Leeward Islands, Guadeloupe, Martinique, Haiti, and Santo Domingo, certain generalizations can be made.

In most of the British islands the rums are more or less highly flavored and are often made by the Jamaican process. Since the sugar industry is generally well developed in these islands, molasses is usually employed as an economical starting material for rum; on account of the fairly strict government supervision, statements as to character and age are reliable. In the islands in which sugar industries are less developed, cane juice replaces molasses as a raw material. Most of the rum produced in the islands listed here is from cane juice fermented spontaneously and distilled on a small scale with rather primitive equipment.

Imitation Rum

Rum is generally more extensively adulterated than any of the commercial spirituous beverage liquors, partly because the general public is not as familiar with true straight or aged rum, but mainly because rum, if not distilled at too high a proof or too well rectified and if properly and sufficiently aged, is naturally aromatic and highly flavored and can give a rum character to a relatively large mass of liquor. A typical imitation rum is sample 65,553 (Table VIII) which is only diluted alcohol processed in tubs with the addition of 1 per cent sugar sirup and caramel coloring. Another brand of this same type contains approximately 2.5 per cent sugar sirup, esters of butyl and ethyl alcohol, cinnamon, vanilla, catechu, and other aromatics, and caramel.

Although some authentic distilled rums are bottled by rectifiers without change, most of their products are blends and imitations. Compounders of imitation rum in the United States usually add ingredients to straight rum, including neutral spirits, fruit juices, sugar, artificial flavoring, and coloring matter.

Rum distilled at low proof and rich in rum character and congenics is sometimes used as a base for neutral spirits and coloring matter. Other types of imitation rums are made by adding commercial essences to neutral spirits and water. Imitation Jamaica rum is sometimes made by adding commercial flavor, sirups, alcohol, and caramel coloring to New England rum. Imitation New England rum is often made with special commercial flavors, sirups, molasses, neutral spirits, and other ingredients.

True rum flavor cannot be imitated any more than true whisky flavor, and any attempt to produce rum flavor artificially is usually readily detected by analyses in which the

United States

Rums produced in the United States, with the exception of most of those produced in Louisiana, may be classed as heavy-bodied rum with a full, rich flavor which is rather raw and not desirable for drinking purposes when new, but which develops an excellent aromatic quality when aged in charred oak barrels. These rums are distilled at a proof below 160°, as required for the New England product. The rums made in Kentucky and most of those in Pennsylvania are of the same type. Pennsylvania also produces a small amount of light-bodied rum, and Louisiana makes a small amount of heavy-bodied rum.

The light rum is distilled at a proof just below 190°, and is usually placed on the market to compete with the Cuban and other light rums imported into the United States. This type of rum has been almost completely stripped of congen-

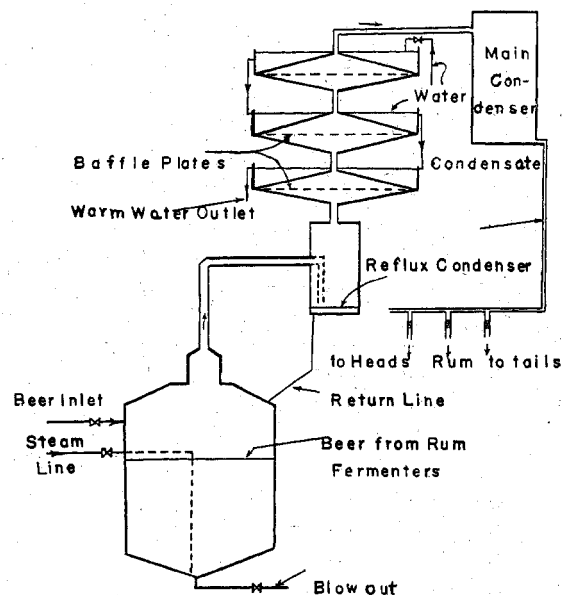


FIGURE 2. SKETCH OF A LOUISIANA RUM STILL

TABLE IX. ANALYSIS OF OLD NEW ENGLAND RUM

Name	Lab. No.	pH	Density	Proof	Grams per 100 Liters						Color in 0.5-Inch Cell	
					Total acids	Volatile acids	Esters	Fusel oil	Solids extract	Aldehydes		Furfurals
Everett	66,220		0.91142	121.8	57.6	52.8	68.6	288.6	155	20	0	9.5
Chapin	67,554	4.07	0.89756	135.2	184.8	148.8	216	450.6	274	48	7.2	18.0

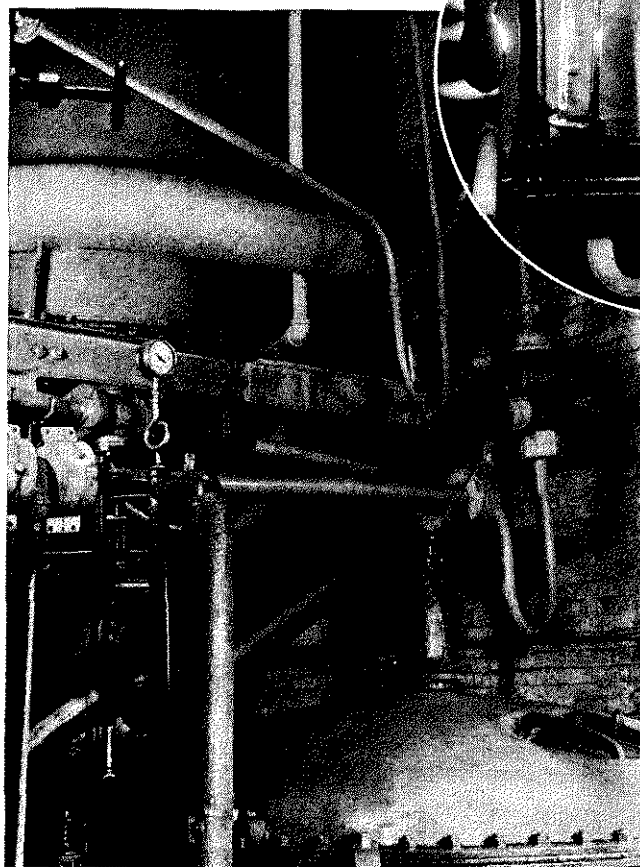
erics, requires and receives little aging, and is weak in rum character, but it is often quick-aged or chip-treated for the production of color.

Table X, rum 8, shows the analysis of a very light Louisiana product which was cleaned almost to neutral spirits by distillation and set aside to observe the changes going on in a new charred and in a re-used barrel during storage.

Table X, rum 7, shows the analysis of heavy Louisiana product which was set aside to mature after quick aging by heating and storing in re-used cooperage.

In order to study the character of the rums manufactured in the United States and the changes taking place in them during wood aging, there were set aside in United States Government bonded warehouses 2 barrels of rum from each rum distillery operating, or which had operated, during the period since the repeal of the Eighteenth Amendment. Samples were taken on or near the date of the entry of the barrels into the warehouses and every 6 months thereafter up to the present time. All the samples, including foreign as well as domestic rums, were completely analyzed at the time they were received, and the congenics were expressed as

STILLS AND (in Circle) TRY BOX FOR CONTROLLING PROOF OF DISTILLATION IN A MASSACHUSETTS RUM DISTILLERY



grams per 100 liters not calculated to 100° proof. Table X includes analyses of the products. Rum 4 (Massachusetts) had already been in new charred white oak barrels for a year when sampled; rum 6 (Massachusetts) had already been in new charred white oak barrels 1.5 years, and rum 7 (Louisiana) had already been 4 months in re-used cooperage when sampled. The other twelve barrels of rum were sampled on or near the date of entry into the government bonded warehouses.

Methods of Analysis

The methods for all rum analyzed here were substantially those of the A. O. A. C. (1) and those described in the work of Valaer and Frazier (11):

PROOF. Pycnometers were used except when the solids were greater than normal (0.2 per cent for aged rum), in which case the liquor was distilled and the pycnometer used.

ACIDS. Total acids were determined by adding 50 cc. of water and 25 cc. of rum to an Erlenmeyer flask, and the mixture was titrated with 0.1 N sodium hydroxide and calculated as acetic acid.

Volatile acids were determined by distillation with steam (using a tube apparatus), until no further volatile acids were distilled. The volatile acids were calculated as acetic.

pH. This new figure in spirits analysis was determined by a Leeds & Northrup potentiometer; it proved a valuable aid in indicating the available acidity and in detecting the presence of any highly ionized acids (10).

ESTERS. The official method was used except that a 10-cc. portion of the distillate was retained for furfural and aldehyde determinations.

TASTE AND ODOR. These properties of rum are so characteristic and so difficult to imitate that they play an indispensable

role in the ultimate analysis of rum.

COLOR. Depth of color was determined in a 0.5-inch standard cell and by the use of the Lovibond tintometer, using the brewer's scale, brown series 52 (11).

FUSEL OIL. These determinations were made more consistent (a) by the use of smaller separatory funnels, with a capacity of about 400 cc. and uniform in size, with which a sharper separation of the immiscible liquids can be made; (b) by the use of all-glass apparatus with universal ground-glass connections, the goosenecks having a small side opening with a small ground-glass stopper by which additional water can be introduced without disconnecting the apparatus; (c) by the use of small pieces of silicon carbide in the oxidizing mixture to avoid any tendency of the liquid to bump during final distillation; and (d) by a careful test with a hydrometer on the filtered sodium sulfate solution for complete saturation at the existing temperature just before using.

ALDEHYDES. The A. O. A. C. official method was used to determine aldehydes in most of the rums analyzed and was checked by the Ripper method (8). The latter gives more consistently accurate results than the A. O. A. C. method. In the Ripper method aldehydes form addition products with sodium bisulfite; the excess is determined by iodometric titrations.

TABLE X. ANALYSIS OF RUMS MANUFACTURED IN THE UNITED STATES

Rum 1, Pennsylvania

Barrel 327,335 made from Java molasses, 54.56 per cent invert sugar, Brix 84.4. Ratio of mash, 4.5 to 1; 5003 gallons of molasses to make 27,352 gallons of beer. Yeast culture developed in a molasses medium for inoculation of a small molasses mash, this in turn used to develop larger yeast mash. Beer column still used. Proof of distillation, 117°. Distillate percolated about 5 hours at 90° F. with toasted chips; approximately

1400 pounds of chips used in a batch of 7935 proof gallons. Cooperage re-used. Storage, brick building, steam-heated; fan blowing hot air into circulation. Approximate winter temp., 70° F.; during summer months, heaters not used. No additional treatment in the warehouse. Barrel 327,820, all conditions the same except the proof of distillation was 121° and there was no chip treatment.

Date Taken	Lab. No.	Serial No.	pH	Proof	Grams per 100 Liters Not Calculated to Proof								Color in Cell	Approx. Age and Comments
					Total acids (as acetic)	Volatile acids (as acetic)	Esters	Fusel oil	Solids	Aldehydes	Furfural			
4/1/35	54,907	327,335	4.66	103	16.8	9.6	16.7	123.0	28	4.4	0.6	2	New, percolated through chips	
10/4/35	60,851		4.44	103	33.6	28.8	21.1	123.2	66	5.1	1.0	5	6 mo.	
4/15/36	66,797		4.46	105.4	38.4	31.2	24.6	124.1	66	6.3	1.2	6	1 yr.	
10/4/36	72,193		4.35	106.4	45.6	33.6	28.2	128.5	94	6.3	1.0	7.5	1.5 yr.	
3/29/37	76,726		4.30	108.8	52.8	39.6	32.6	126.7	106	6.6	1.0	8.0	2 yr.	
4/1/35	54,908	327,820	4.76	103.0	9.6	9.6	16.7	123.2	8	4.4	0	0.2	New	
10/4/35	60,852		4.54	103.6	33.6	26.4	23.8	124.3	48	4.7	Trace	4	6 mo.	
4/15/36	66,796		4.52	104.8	36.0	28.8	26.4	124.0	50	5.5	0.8	4.5	1 yr.	
10/4/36	72,194		4.46	105.6	43.2	33.6	29.0	128.5	78	6.4	0.8	6.5	1.5 yr.	
3/29/37	76,727		4.44	107.8	50.4	40.8	33.4	132.0	94	6.8	0.8	7.0	2 yr.	

Rum 2, Kentucky

Rums from barrels 69,689 and 69,690 produced in a pot still, capacity 19,776 gallons. Proof of distillation, 135° (average); composition of mash, 6 parts water and 1 part blackstrap molasses, with pure yeast added. Balling, 15°; specific gravity, 1.0613. No quick age or chips employed. Cooper-

age, new charred white oak barrels; warehouse brick with concrete floor. Temperature first year 85-90° F. (steam heat); after that, 70-72° F. Original wine gallons, 48.5 and 47.28; original proof gallons, 48.99 and 47.75, respectively.

3/24/35	55,215	69,689	4.28	102	14.4	14.4	43.1	102.1	16	40	5.5	0	New
10/2/35	60,798		4.33	102.2	69.6	52.8	47.5	103.4	136	40	8.2	11.0	0.5 yr.
5/23/36	68,497		4.17	104.4	80.4	67.2	60.7	108.6	168	40	8.2	13.5	1 yr.
9/23/36	72,890		4.13	104.8	84.0	67.2	65.1	117.1	184	40.1	10	16.5	1.5 yr.
3/23/27	76,714		4.28	106.8	88.8	73.2	73.0	116.2	204	34.3	12	17.0	2 yr.
3/25/35	55,216	69,690	4.20	101.2	14.4	14.4	36.9	102.6	12	40	6.3	0	New
10/2/35	60,799		4.20	101.6	62.4	52.8	47.5	107.4	126	40	7.5	9.0	0.5 yr.
3/25/36	66,437		4.25	103.6	69.6	62.4	51.0	110.9	140	40	7.5	11.5	1 yr.
9/23/36	72,891		4.13	105.2	76.8	62.4	56.3	117.9	168	42.3	10	14.0	1.5 yr.
3/22/27	76,715		4.30	107.2	81.6	68.4	64.2	119.7	182	37.0	12	14.0	2 yr.

Rum 3, Massachusetts

Rum distilled in continuous-type still; capacity, 6834 gallons of beer without doubler; rectifier used to keep up proof of spirits. Proof when distilled, 121°; reduced to 100° proof in cistern before being drawn off into barrels. No quick ager applied to spirits before warehousing. Cooper-

age, new charred white oak barrels. Warehouse constructed of brick with wooden floors, steam-heated in winter. Average temperature about 70° F. during year. Samples have fine rum flavor. Neither barrel was sampled at the 1-year period through an oversight.

3/8/35	56,291	123,066	4.68	100.6	38.4	36.0	22	91.7	6	4	1.2	0	New
9/10/35	60,647		4.42	100.4	84.0	74.0	29.0	91.5	86	6.4	1.2	7.5	6 mo.
9/16/36	71,652		4.37	101.4	93.4	86.4	45.5	93.3	142	7.2	1.4	11.0	1.5 yr.
3/15/37	76,691		4.30	102.4	98.4	86.4	51.0	96.8	162	7.2	1.6	13.0	2 yr.
3/8/35	56,292	123,067	4.44	100.6	38.4	36.0	21.1	91.3	6	4	1.2	0	New
9/10/35	60,648		4.42	100.6	84.0	69.6	29.9	91.5	88	6.4	1.3	7.5	6 mo.
9/16/36	71,653		4.35	101.6	96.0	86.4	45.8	92.4	138	7.0	1.4	11.0	1.5 yr.
3/15/37	76,692		4.30	102.4	98.4	85.2	49.3	100.3	156	7.4	1.8	13.0	2 yr.

(Continued on page 999)

The Barrel

The data given in Table X show that the acids, esters, solids, color, and, no doubt, other substances increase faster and in greater proportions in new charred cooperage than in barrels which have previously been used. In the latter case the gains are usually smaller, slower, and somewhat variable, probably depending a great deal on the number of times the barrel has been used and its general condition.

Table XI shows that re-used barrels weigh 91 to 106 pounds (average 98) before filling and that new charred barrels weigh 78 to 91 pounds (average, 84) before filling. The loss of spirits in storage was more uniform in the case of the new charred packages than in the case of the re-used packages; the losses were sometimes higher and sometimes lower than those sustained by the new charred barrels.

Legal Status of Rum

Various governmental agencies are more or less concerned with the composition of rum, including the Bureau of Internal Revenue, the Federal Alcohol Administration, the Food and Drug Administration, and A. B. C. Boards of the several states.

The Bureau of Internal Revenue recognizes the product of

the fermentation of sugar cane and its by-products as rum if it is distilled at not over 190° proof (after that it is legally spirits), and a tax of \$2.00 a proof gallon is imposed on all such rum if it is 100° proof or above; if below proof, \$2.00 a wine gallon. Any treatment not in the distillery or bonded warehouse, other than simple filtration in which no change occurs, must be conducted by a duly qualified rectifier. If rum like most foreign rums were manufactured in the United States or its possessions to which the Internal Revenue laws apply, it would have to be made by a rectifier, and a tax of 30 cents per proof gallon would be levied on the product in addition to the \$2.00 per gallon, on account of the ingredients usually incorporated into the product after distillation.

The Federal Alcohol Administration promulgated regulations relating to standards of identity for various classes of rum. Rum must have its origin in sugar cane or sugar cane by-products and be distilled at a proof less than 190°, and the distillate must possess the taste, aroma, and characteristics generally attributed to rum. New England rum must be produced in the United States and distilled at less than 160° proof, and cannot be a mixture. Rum from the numerous producing islands must be made in the region indicated by the name.

TABLE X. ANALYSIS OF RUMS MANUFACTURED IN THE UNITED STATES (Continued)

Rum 4, Massachusetts

Rum distilled in continuous-type still and rectifying column combined; capacity, 1250 wine gallons of 120° proof every 8 hours. Original proof of rum, 145°. Processed by being passed through a basket of charred oak chips inside a percolating tank, and circulated by means of a pump through the chips for 10 minutes. Package 8 was newly charred; package 23 was

a re-used barrel. Warehouse heated, average yearly temperature 80° F. Heating system is a steam coil unit inside a humidifier, which sprays the barrels with hot vapor; relative humidity 85 per cent. Serial 8 produced 8/28/24, original proof 95°; serial 23 produced 8/29/34, original proof 96°. Esters developed faster in re-used than in newly charred barrel.

Date Taken	Lab. No.	Serial No.	pH	Proof	Grams per 100 Liters Not Calculated to Proof					Color in Cell	Approx. Age and Comments		
					Total acids (as acetic)	Volatile acids (as acetic)	Esters	Fusel oil	Solids			Aldehydes	Furfural
9/26/35	60,649	8	4.43	97.8	91.2	84.0	34.3	196.4	80	5.0	1	3.5	1 yr.
5/30/36	68,285	...	4.43	95.4	88.8	79.2	34.3	204.2	142	5.2	0.8	8.0	1.5 yr.
11/4/36	74,544	...	4.36	94.8	91.2	81.6	34.3	191.8	150	5.4	1.2	8.5	2 yr.
3/1/37	76,787	...	4.35	94.8	91.2	85.2	38.7	191.8	176	6.4	1.2	10.0	2.5 yr.
9/26/35	60,650	23	4.52	96.8	88.8	76.8	22.9	187.3	102	5.0	1.0	7.5	1 yr.
5/30/36	68,286	...	4.33	97.6	93.6	81.6	44.9	198.9	104	5.5	1.2	6.0	1.5 yr.
11/4/36	74,546	...	4.20	96.8	96.0	86.4	51.9	204.2	102	5.1	1.2	5.0	2 yr.
3/1/37	76,788	...	4.20	96.8	96.0	86.4	55.4	212.9	110	5.9	1.2	6.0	2.5 yr.

Rum 5, Massachusetts

Molasses mash, distilled in pot still and doubler; working capacity of still, 1000 gallons; doubler capacity, 430 gallons. Beer heater used. Charge of 1000 gallons is dropped from beer heater into still; at the same time the

high and low wines (heads and tails) are dropped into the doubler. Proof of distillation, 153°. No quick aging. New charred white oak barrels. Normal humidity. Average temperature of warehouse 70° F. (steam heated).

6/13/35	58,256	540	5.23	103	4.8	4.8	21.1	98.6	12	7.0	3	0	New
12/13/35	64,571	...	4.40	102.4	48.0	48.0	22.9	98.6	92	7.5	5	7	6 mo.
6/13/36	70,034	...	4.26	102.6	55.2	48.0	22.0	98.6	120	8.0	8	8	1 yr.
12/17/36	74,548	...	4.30	102.4	64.8	52.8	25.5	98.8	128	8.4	6.5	9	1.5 yr.
6/12/37	79,311	...	4.23	103.4	67.2	62.4	27.3	100.0	142	8.91	6.4	10.5	2 yr.
6/17/35	58,257	570	5.28	102.8	4.8	4.8	18.5	98.6	12	6	4.8	0	New
12/17/35	64,572	...	4.40	102.8	48.0	48.0	22.9	98.6	84	7	5	7	6 mo.
6/17/36	70,035	...	4.30	102.6	54.6	48.0	22.9	99.4	108	7.2	7.5	7.5	1 yr.
12/17/36	74,549	...	4.33	102.8	60.0	55.2	25.5	100.3	114	7.4	6.0	8.5	1.5 yr.
6/17/37	79,312	...	4.23	103.6	62.4	56.4	29.9	102.1	130	7.7	6.4	9.0	2 yr.

Rum 6, Massachusetts

Rum distilled April 4, 1934. Continuous-unit still with capacity of 1200 gallons of beer an hour; doubler capacity, 845 gallons. Original proof 135°. No quick aging. Cooperage, new charred white oak. Pack-

age 24 originally contained 46.06 wine gallons and 46.52 proof gallons; package 66 originally contained 45.42 wine gallons and 45.87 proof gallons. Warehouse of wood construction, average storage temperature 75° F.

9/27/35	60,659	24	4.48	103.4	67.2	55.2	35.2	174.2	156	7	1.5	10.5	1.5 yr.
3/27/36	67,301	...	4.38	104.8	74.4	55.2	40.5	176.0	178	9.6	1.4	11.0	2 yr.
9/25/36	72,147	...	4.39	105.0	74.4	64.8	39.6	178.0	180	9.0	1.0	13.0	2.5 yr.
3/25/37	76,984	...	4.42	106.2	72.0	62.4	42.2	179.8	182	7.3	1.2	14.0	3 yr.
9/27/35	60,660	66	4.42	104.4	67.2	40.8	33.4	176.7	164	8	1.0	10.5	1.5 yr.
3/27/36	67,302	...	4.35	105.6	69.6	43.2	36.9	182.5	176	12	1.2	11.0	2 yr.
9/25/36	72,148	...	4.37	105.8	72.0	57.6	38.7	185.4	188	10	1.0	13.0	2.5 yr.
3/25/37	76,985	...	4.35	107.2	72.0	61.2	40.5	196.4	190	8.5	1.2	14.0	3 yr.

Rum 7, Louisiana

Rum made from Louisiana blackstrap molasses in standard rum still. Distilled at 159° proof, bonded February 18, 1936, in re-used cooperage. Serial No. 3516 quick-aged for 10 days at maximum temperature of 160° F.

Serial No. 4011 percolated over charred oak chips and quick-aged for 10 days at maximum temperature of 160° F.

6/3/36	68,506	3516 (A. G. grade)	3.92	104.2	48	31.2	32.6	161.9	40	37.8	0.8	6	3.5 mo.
12/22/36	74,410	...	3.90	105.2	55.2	36.0	36.1	161.8	106	38.5	1.2	7.5	9.5 mo.
6/15/37	79,209	...	3.82	106.4	57.6	36.0	43.1	165.4	114	21.2	1.6	8.0	15.5 mo.
6/3/36	68,507	4011 (W. grade)	4.33	102	38.4	26.4	25.5	163.7	140	25.1	2	14.0	3.5 mo.
12/22/36	74,411	...	4.28	103.4	48.0	31.2	25.5	167.2	174	25.9	2	19.5	9.5 mo.
6/15/37	79,210	...	4.22	104.8	50.4	32.4	31.7	171.1	184	23.1	2.4	20.0	15.5 mo.

Rum 8, Louisiana

Rum distilled through American-type beer still at 118° proof, then through American-type redistill; finished rum went into receiving tanks at approximately 189° proof, then was reduced in proof 110°. Serial No. 9657 aged in a new charred barrel; serial No. 9680 in re-used barrel with 1 pound of oak chips. Both samples bonded in barrels December 2, 1936. Barrels

gaged at each sampling. Still No. 1 beer column, 5 feet diameter, 36 feet high; No. 2 beer column, 4 feet diameter, 34 feet high. Ordinary condenser, no dephlegmators. Kettle still, 10,160 gallons, with column 4 feet in diameter, 36 feet high, dephlegmators and condenser.

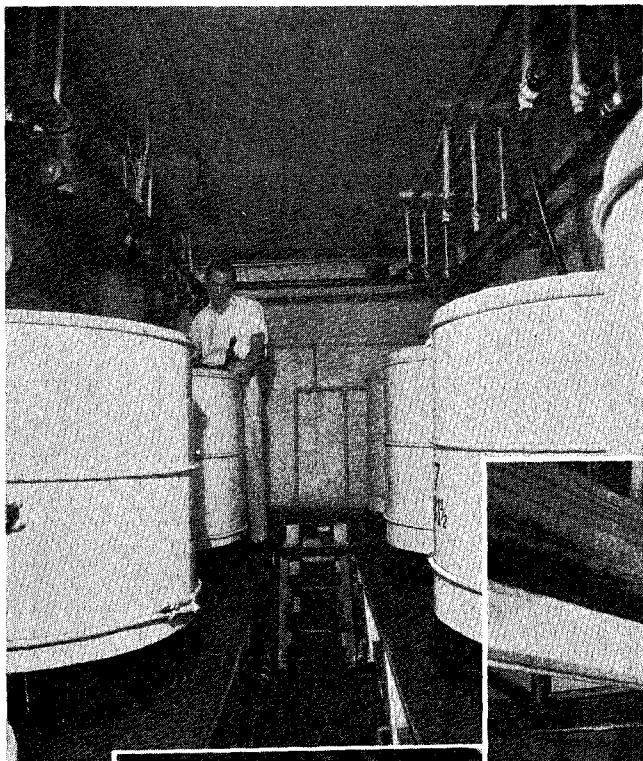
12/7/36	74,412	9657	5.38	110	7.2	4.8	6.16	15.8	14	1.76	0	1.5 (5 days in wood)	New, like diluted neutral spirits
6/15/37	79,207	...	4.53	109.6	38.4	32.4	11.4	15.8	80	3.3	0.56	...	6 mo.
12/7/36	74,413	9680	6.0	110	6.0	4.8	6.16	17.6	6	1.54	0	2.0 (5 days in wood)	New, like diluted neutral spirits
6/15/37	79,208	...	5.2	110.4	9.6	6.0	7.04	22.9	38	2.3	0.16	...	6 mo.

Maple Sirup Distillate 9, Vermont

Mash made direct from heavy maple sirup, water, and fermenting agent. Six fermenters used in rotation, 6-day periods. Capacity, 1800 gallons of product per day. Still is continuous, with five main sections and a total of fifteen plates, beer heater, and condenser. Capacity of still, 90 proof gallons

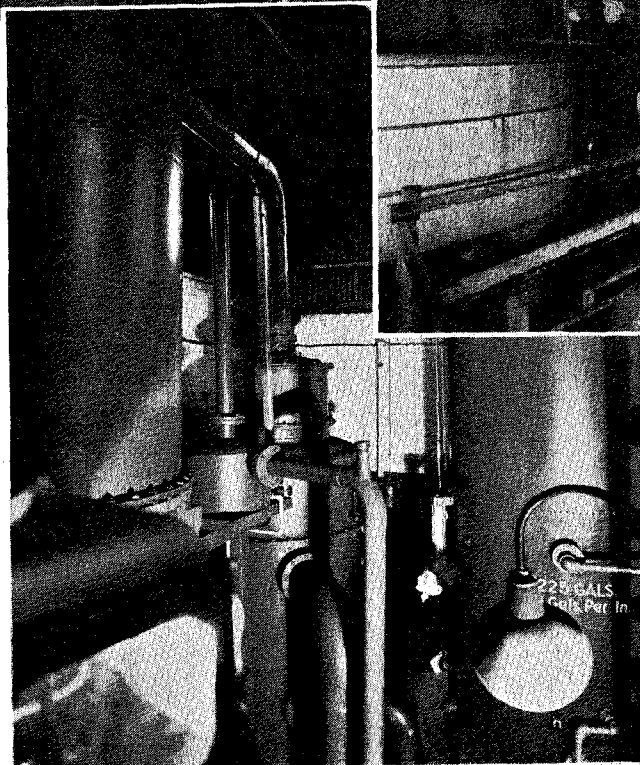
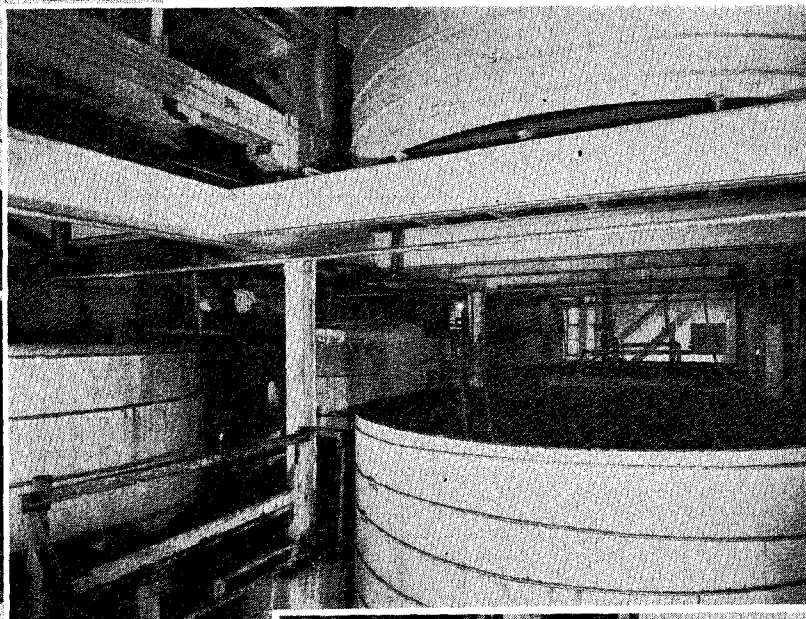
per hour. Sample 302 distilled at 114° proof and 342 at 120° proof; both reduced in cistern room to 102° proof. No quick ager used. Stored in new white oak charred barrels (half-packages). Warehouse, brick and cement foundations, 4 floors, steam-heated. Average temperature, 75° F.

9/12/36	72,152	302	5.35	102.6	9.6	8.4	18.5	110.9	16	26	0	0.5	New
3/12/37	76,789	...	4.56	104.0	55.2	45.6	26.4	117.9	114	13.5	0.8	8.5	6 mo.
9/12/36	72,153	342	5.50	101.6	7.2	7.2	18.5	119.7	5	20	0	0	New
3/15/37	76,790	...	4.47	103.8	57.6	50.4	24.6	122.3	120	16.1	1.2	8.5	6 mo.

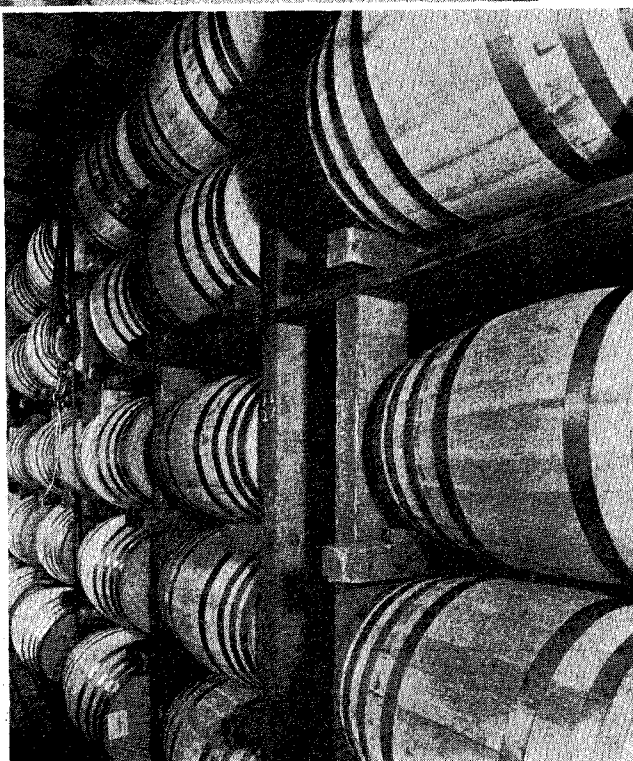


Views in a Kentucky Rum Distillery

(Left) YEAST ROOM
(Below) FERMENTING ROOM



(Above) SECTION OF STILL ROOM
(Right) SECTION OF RICK WAREHOUSE



Under the Federal Alcohol Administration regulations, neutral spirits, spirits other than rum, or rum-flavoring material added to rum, causes it to become an imitation rum.

The Food and Drugs Act is written in general terms and does not deal specifically with rum; however, rum which is shipped in interstate commerce or offered for import into the United States should comply with the general provisions of the Act relating to the adulteration and misbranding of foods.

The various states, with very few exceptions, follow the standards for rum set by the Federal Government.

The Future

The methods of chemical analysis of distilled spirits are swiftly catching step with the rapid march of science, and are improving in sensitivity, accuracy, and consistency. The new approach is not only to determine congeners in groups but to isolate and identify the numerous members contained in the less than 0.5 per cent of material that distinguishes rum, brandy, whisky, and other distilled liquor from just a mixture of alcohol and water. During the past two years many excellent papers have given new information concerning the composition of distilled spirits. Rum and other spirituous liquor will be fractionated in high-vacuum superstillers into individual compounds. Out of this knowledge new methods will develop, older methods will become more concise and comprehensive, and the chemistry of distilled spirits will rise to as high a scientific plane as any class of material.

Conclusions

1. The rums produced in the United States, with the exception of some made in Louisiana, may be classed as heavy-bodied rums. They are distilled in the manner of straight whiskies at a proof below 160°, and most of them are being aged for a period of 4 years or more in new charred white oak barrels in United States bonded warehouses.

2. Rums produced in other countries, with very few exceptions, grade from medium-bodied to very light-bodied (almost neutral spirits in character). With the exception of authentic Jamaica and St. Croix rums, most of the basic characteristics by which we recognize foreign rums are obtained from the added ingredients.

3. The rums distilled in the United States contain only the congeners that go over during its final distillation, those which are developed, and those extracted during the process of aging in charred white oak barrels.

4. No coloring matter is added to rums in the United States by the distillers, but some of the rums are given an initial treatment with charred chips. No ingredients are legitimately added to United States rums except by duly qualified rectifiers who blend rum and compound imitation rum.

5. With very few exceptions, foreign rums are rectified in the sense that they are artificially colored (this is permitted in most rum-producing countries); with the exception of Jamaica and St. Croix, they are rarely found without some added ingredient contributed to produce certain desired characteristics.

6. The quantity of esters found in straight rums is not any greater than that found in straight whisky and is usually less than in straight brandy.

7. New England (Massachusetts) produces the rums distilled at the lowest proof with a resulting higher congeneric

TABLE XI. SHOWING WEIGHT OF BARRELS AND LOSS IN WINE GALLONS AND PROOF GALLONS OF RUM DURING STORAGE (FROM GAGERS' REPORTS)

Serial No.	Kind	Tare Weight, Lbs.	Original Gage		Gage after 18 Mo. ^a		Gage after 24 Mo. ^a		Loss of Spirits (W. G.) ^b	
			W. G.	P. G.	W. G.	P. G.	W. G.	P. G.	In 18 Mo.	In 24 Mo.
327,835	Re-used	91.0	45.1	46.0	38.7	41.0	36.3	39.2	6.4	8.8
327,820	Re-used	91.2	43.8	44.7	36.5	38.3	31.0	33.5	7.3	12.8
69,689	New	85.0	48.5	49.0	41.2	43.3	39.4	41.8	7.3	9.1
69,690	New	81.0	47.3	47.8	39.7	41.7	37.6	39.8	7.6	9.7
123,066	New	91.0	46.0	46.0	41.7	42.6	41.0	41.8	4.3	5.0
123,067	New	91.2	46.4	46.4	41.5	42.4	40.5	41.3	4.9	5.9
8	New	87.0	46.5	47.0	42.7	40.6	41.0	38.9	3.8	5.5
23	Re-used	96.2	46.7	46.7	42.8	41.1	41.1	39.9	3.9	5.6
540	New	78.2	47.6	49.1	42.0	43.2	42.3	43.6	5.6	5.3
570	New	82.2	47.9	49.3	43.4	44.7	42.2	43.9	4.5	5.7
24	New	86.0	46.1	46.5	37.3	39.2	36.0	38.2	30 Mo. 8.8	After 36 Mo. 10.1
66	New	82.0	45.4	45.9	36.2	38.0	34.7	36.8	9.2	10.7
3,516	Re-used	106	46.2	47.5	43.5	45.2	41.0	43.1	3 Mo. 2.7	9 Mo. 5.2
4,011	Re-used	103	48.2	48.7	45.0	45.5	41.8	43.0	3.2	6.4
9,657	New	83.2	50.3	55.3	47.1	51.4	After 6 Mo. 3.2	...
9,680	Re-used	101	46.9	51.6	45.4	49.9	1.5	...

^a Amount of sample taken was not subtracted.
^b Includes samples taken.

content, particularly higher alcohols. Jamaica produces the heaviest of the foreign rums, and Cuban rums as a class appear to be the lightest in body and color.

8. As with whisky, the constituents of rum are continually undergoing changes during storage in wood. The largest increase in acids, esters, solids, and color is during the first 6 months of storage. After 2 years the increase in congeners by development and concentration is very slow.

9. Although considerable emphasis is placed on esters (often erroneously referred to as "ethers") in some foreign rums, no special attention is paid to these particular congeneric substances in the United States. Only when the United States rums are newly distilled (as with whiskies) do the esters exceed the acids; after less than 6-month storage the ratio is changed, and after 2 years the esters are usually a little more than half the acid content.

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