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Rum Manufacture

J. A. P. I'Anson*

Rum manufactured in the Caribbean usually first involves pretreating the molasses, followed by fermentation. All rum used then to be distilled in pot stills, but continuous distillation, using four columns, is now favoured to meet the demand for a large range of rum types. Analytical comparisons of different types of rum reinforce the suggestion that the legal maturation period could be shortened to one or two years for the lighter rums.

THE official British definition, dating back to 1909, states that 'Rum is a spirit distilled direct from sugar-cane products in sugar-cane-growing countries'. A book on Barbados has described the spirit as 'Rumbullion'. 'Rumbullion' or 'Rumbustion' was apparently shortened to 'Rum'. Other people have tried to establish that the name is derived from the last syllable of the Latin word for sugar, Saccharum, but the author sees no reason to suppose that the word did not originate in the British West Indies, from the Devonshire word 'Rumbullion'.

During the reign of Charles II, rum became the recognised term for sugar-cane spirit produced in the British West Indies and, by the early 18th century, rum became well known in England, particularly those rums produced in Barbados, Jamaica, Demerara, and Trinidad.

This article describes rum manufacture based on current production in the Caribbean. This is one of the world's largest producing areas and probably makes not only a very high proportion of the great names in the rum trade, but also a greater variety of types of rums, from the lightest continuous-still rums, to the heavy and dark traditional Navy pot-still rums.

Rum can be made, and small quantities are, from pure sugar-cane juice and partly-refined sugar. However, there is not the space in this article to describe these special types of rum distillation.

Because of the dependence of rum distillers in the past on molasses from the sugar industry, most rum distilleries were attached to a sugar factory and were probably owned by the same company. Today this is not necessarily the case, and most modern and progressive rum distilleries are not attached in any way to sugar production.

Raw materials

The raw material, for all types of rum discussed in this article, is molasses. Molasses is a byproduct of the sugar industry. It is the thick dark treacly substance which remains as the mother liquor when the last of the sugar crystals have been spun out in the centrifuging process of sugar refining. Depending on the variety of sugar cane, the processes used, climatic conditions and a host of other variables, the mineral quality and sugar content of the molasses varies, and naturally so does the quality of the rum to be made.

A typical chemical analysis of molasses would be as follows:

Brix° (density)	85·00
Total sugars (as invert)	52·00%
Ash	8·00%
Nitrogen	0·75%
Gums	2·50%
pH	5·5

The overall chemical composition varies with the quality of molasses. Good molasses should have a sweet and fresh smell and should taste not only sweet but sound, i.e. not fusty or stale, which probably denotes long storage in bad conditions.

The molasses once, purchased, is stored in the distillery in large mild steel tanks. The author favours the storage of molasses in covered, well-ventilated and clean tanks for three to four months. Not only does this 'cooled' molasses give a rum with an improved bouquet or fragrance, but it allows for easier fermentation, improved fermentation yields, and lessens the tendency to scale in the distillation columns.

Molasses pretreatment

The first stage in rum manufacture is the conversion of the sugars in the molasses to alcohol, and the many compounds produced during fermentation, which together finally give the rum its distinctive characteristics. Before this, however, molasses must be pretreated. This is very much a question of personal preferences.

Some of the main reasons for molasses treatment are described below.

(1) Heating, cooling and clarification will ensure minimum deposition of crystalline calcium sulphate on the interior surfaces of the analysing column of the distillation unit, during the initial distillation process. Whilst this pretreatment can often eliminate the tendency to scale, which is damaging to the still, distillation efficiency and product quality and can lead sometimes to complete stoppage of the distillation process, it is not an ideal solution. Even after heat treatment with H_2SO_4 and subsequent centrifuging of the precipitated $CaSO_4$, it is often found that residual $CaSO_4$ in solution might precipitate in the still, if, for instance, there is a case of poor still design, allowing refluxing of hot alcohols feints from the rectifier to the feed plates of the analysing column. Alternatively, scaling can be virtually eliminated by the injection of special proprietary compounds into the wash feed pipe to the analyser column.

(2) Sterilisation of molasses will ensure minimum bacterial infection during fermentation.

(3) Centrifuging of diluted molasses, with or without heating, will eliminate most muds and solids, held to be deleterious to the fermentation process, and subsequently the final rum quality.

Some distillers spend considerable time and money on treating the molasses with H_2SO_4, with subsequent heating, followed by cooling and settling out or centrifuging. While certainly reducing the calcium sulphate, muds and solids, this treatment causes a consequent undesirable loss of sugars. Other processes are used to clarify the molasses, by which it is hoped to improve fermentation and distillation efficiency. In many cases these processes are essential, but each case must be judged by its own merits or demerits, i.e. type of molasses used, type of still, etc., not to mention capital expenditure. There is no hard and fast rule for molasses pretreatment, if any.

Addition of water

The last stage in its pretreatment before fermentation is the addition of water, which lowers both the viscosity of the molasses and its sugar content to a concentration at which fermentation can take place. At this stage it is usual to adjust the pH of the wash, for maximum anti-bacterial action and fermentation efficiency. Also, yeast nutrients, usually ammonium sulphate or urea, are added.

Until about four years ago, most tropical distillers carried out this final dilution, by means of mixing given quantities of acid for pH control and ammonium sulphate

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for nutrient purposes, with molasses and water in large mixing tanks.

One of the most onerous operations in the whole process of rum and alcohol production from molasses is the initial mixing of the molasses and water to obtain the correct density suitable to the particular fermentation process. Not only does this mixing process use valuable space in the form of mixing and transfer tanks, but it is also extremely costly in both time and labour. The author's company has developed a packaged semi-automatic unit to operate this process. It has been tried and tested and it is now being used in many other distilleries. In a space of only about twice the size of an office desk it is now possible to mix molasses and water to any required density and to mix continuously at a rate of flow comparable to that of the fermented wash being fed to the analyser column of a continuous distillation unit (Fig. 1).

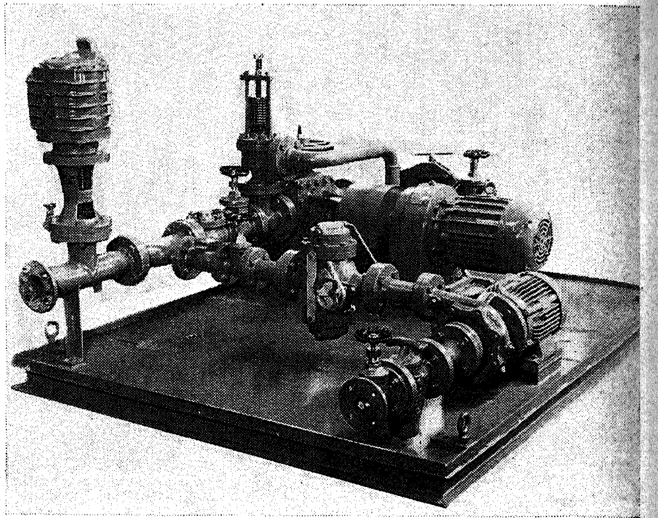

Fig. 1. Molasses water mixing unit

The use of this molasses/water mixer gives the distiller the following technical and economical advantages: accurate density settings; intimate mixing of the molasses and water, resulting in increased fermentation efficiency; continuous flow to fermentation and distillation processes; elimination of all intermediate holding tanks, etc.; virtual elimination of labour, and certainly the elimination of shift work; and complete cleanliness in operation.

The following comparative figures were obtained at a distillery in Guyana after installation of this plant:

	Previous method	*New method*
Gal molasses/gal proof spirit	1·5	1·25
Percentage alcohol yield after fermentation	7·7%	8·9%

At the same time the molasses and water are being mixed, accurate quantities of inorganic acid, usually H_2SO_4 or HCl, together with liquid nutrient, are metered into the mixture at the appropriate feed point.

Fermentation

At this stage in the process, the fermenting vessels, usually of mild steel and varying in size depending on distillery throughput, from 10,000–40,000 gal (20,000 or thereabouts appears to be the size most favoured) are filled with liquid, in this case called wash, and have the following typical composition:

Density (° Brix)	17–18
pH	5·5
Total sugars (g/100 ml wash)	10–12
Nitrogen (mg/100 ml wash)	225

Thus this mixed wash is ready for fermentation after a 2–3% addition to the fermenter of highly-activated yeast, produced from selected yeast strains in a specially tropically-adapted yeast-culture plant (Fig. 4).

For rum manufacture, a yeast strain is required that ideally should have certain characteristics:

(1) it should be suitable for the highest alcohol yield (sugar utilisation) compatible with local operating conditions such as ambient temperature, water analysis, etc.;

(2) it should be suitable for producing the correct flavours and bouquet in the final product by having adequate yields of the appropriate types of the following organic byproducts of fermentation. These are vital in the preparation of fine-quality rums, and are: organic acids, aldehydes, esters, and higher alcohols; and

(3) it should ferment rapidly thereby minimising the risk of infection and further interaction of desired compounds, formed as mentioned in *(2)* above.

The outflowing yeast from the yeast plant is pumped to one of four stainless steel propagation tanks, where it is run to whichever fermentation vessel is being filled at that time. The sudden addition of a relatively large amount of actively working yeast, into the incoming wash feed, starts the main fermentation.

By the time the fermenting vessel is filled, fermentation is proceeding at full pace, and it is at this stage that cooling of the fermented wash is not only advisable, but, for maximum fermentation efficiency and final product quality, cooling of fermenting wash is imperative. In the old days, fermentation was carried out in wooden vessels, relying on the indigenous airborne or vat stave inoculated yeast to carry out the process. If, for instance, as in the case of most Caribbean areas, the initial temperature of setting wash was 27–28°C, then within about 20 hr of starting fermentation, temperatures would have risen to 37–38°C. This resulted in the loss of yeast activity, resulting in inefficient conversion of sugars, giving a low yield of alcohol, together with the accompanying production of unwanted fermentation byproducts which produce a poor-quality end product.

Cooling

Over the years, many methods of cooling this fermentation process have been tried. These included attemperation coils, outside spray rings, when mild steel fermenting vessels replaced wooden ones, and passing the fermenting wash through outside heat exchangers and returning to the fermentation vessel. However, all these methods had one basic flaw, which was the fact that the cooling medium, i.e. local river or well water, was at a similar temperature to that of the wash. Usually the same water was used for both purposes, so that at maximum yeast activity one might only have a temperature differential of 5°C.

The author's company have developed a system for this problem. They utilise the transference of the fermenting wash through plate heat exchangers and returning to the fermenting vessel. The counter-flowing water though is prechilled. This chilled water is produced from a completely packaged fully-automatic unit. During tests, fermentation has been able to be totally arrested.

Temperature

Fermentation temperatures are usually held at 31 or 32°C. Lower temperatures are possible, but against the minimal advantages of higher alcohol yields, and better fermentation qualities, should be set the added disadvantage of added operational costs, larger holding time in the fermentation vessels, and a greater chance of contamination and alcohol loss by evaporation, if the fermentation house is not equipped with CO_2 collection and scrubbing.

Fermentation separation

After 36–48 hr, depending on the yeast type, locality, etc., fermentation is completed. Once fermentation has ceased, the fermentation vessels are allowed to rest for about 6 hr, to settle out dead yeast, etc., as muds on the fermentation vessels bottoms. The contents are then ready for transposing to the distillation process.

In some instances, the now super latent fermented wash is drawn off, and pumped to the overhead wash feed tank on the top floor of the distillation house. The muds at the bottom of the fermentation vessel are run to waste. In other cases the total outlet of the fermentation vessel before settling after fermentation, is passed through a centrifuge, the clarified wash being pumped to the overhead wash feed tank and the dead yeast and muds being diverted to a separate tank for conversion to yeast adjunct for cattle, or to waste, as the opportunity and commercial consideration favours.

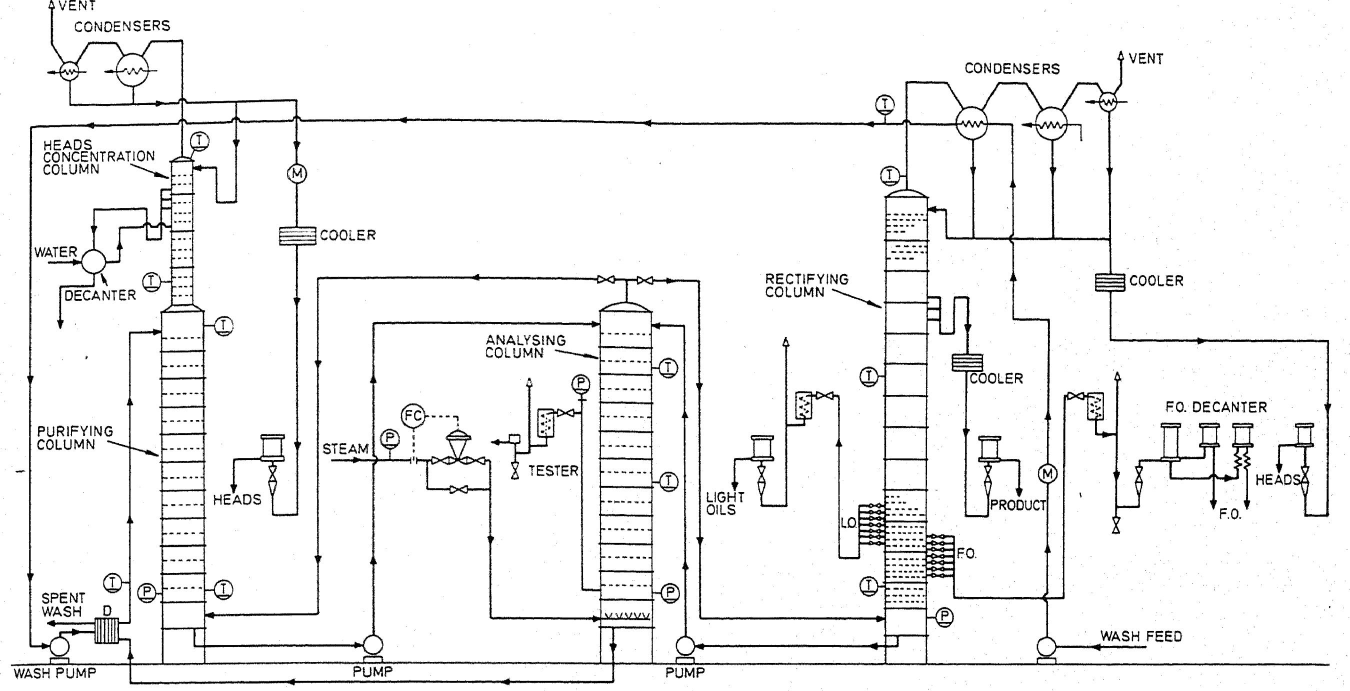

Fig. 2. Flow diagram of a typical rum distillation plant

Centrifuging

There are several advantages in using a centrifuge at this stage. A clarified wash will inhibit heavy scaling in the analysing column of the still if there is a tendency for calcium sulphate to crystallise. This subject has already been discussed previously under molasses pretreatment.

There is an improvement in distillation rate.

There is an improvement in rum quality due to the relative absence of the putrefactious products of dead yeast cells and the fermentation vessel muds.

It gives utilisation of separated yeast etc., for commercial purposes.

The author's company are now conducting detailed experiments with regard to the relative qualities of the final distillates from centrifuged or non-centrifuged washes.

The alcohol content of the wash, pumped from the fermentation vessel to the distillation unit, will be of the order of 6·5–9%.

Continuous distillation

Continuous distillation is the method favoured by the majority of rum distillers today. The number of pot-still plants grows smaller each year, as world demands for rums, light both in flavour and bouquet, increase. This is indicative of the general change in consumer preference for the lighter types of rum, as against the heavier pot-still types. For reasons of space in this article, the author will concentrate mainly on the continuous distillation methods.

At the turn of the century, in what was then the British Caribbean, consisting basically of British Guiana, Trinidad, Barbados and Jamaica, as major suppliers of rum to the UK, there were a great number of pot-still plants, but the continuous still was slowly growing in favour. Early continuous stills were basically of the two-column Coffey type with a smattering of German or French type two-column stills.

These early type continuous stills produced, in all probability, only one type of alcohol or rum, and were perfectly satisfactory then. However, since the second world war, the product variety of many rum plants has broadened widely, mainly due to the many commercial possibilities open to the rum distiller, such as the manufacture of local gin, vodka, liqueurs, blended whisky, etc. The majority of modern molasses distilleries and those being built would probably have to be capable of producing the following products:

Type *1*.—Extra light and fine-quality rums and very high-grade potable alcohol, the latter for eventual conversion to gin, vodka, liqueurs, etc.

Type *2*.—High-grade rums of greater impurity content and potable alcohol to suit local and overseas markets.

Type *3*.—Heavier-type rums for export to overseas markets specialising in the more traditional coloured products.

Thus it is readily seen from the above that the distillation unit of any rum distillery must be most versatile. The design of a distilling apparatus to produce such a large range of rum types naturally will be very much more complex than that of a still for just one product. Basically it consists of four separate distilling columns: a purifying column, a heads concentration column, an analysing column and a rectifying column.

The purifying and analysing columns are of 16 and 20 plates, respectively, consisting of inverted, trough-type non-serrated caps. The sections between each plate have glass man-doors to allow easy inspection and cleaning, without the necessity for dismantling the column, as even with the most efficient wash pretreatment, there will always be a natural buildup of a certain quantity of muds over a period of time.

The heads concentration columns and rectifying columns consist of close-set plates, 20 and 64, respectively. The condensers for all the above columns are inter-connected and are designed to give minimum steam consumption at any setting. In addition, a complex system of refluxing allows for maximum versatility, with regard to flavour and strength of the particular end product.

Below are given, by way of example, the methods of operating the plant for Types *1* and *2* at, say, 68–69 o.p. and Type *3* at 65–68 o.p. (Fig. 2).

In types *1* and *2*, all four columns are used. The preheated wash is fed to the purifier column *A*, where CO_2 and noxious gases are eliminated. A small percentage of aldehydes and other heads fractions passes to the heads concentration column where they are drawn off. The now purified boiling wash is pumped to the feed plate of the analyser column. Direct steam, controlled by the steam regulator, is injected at the base of this column.

The vapours leave the top of the analyser by way of a foam breaker, the main vapour stream passing to the base of the rectifying column, where both low and high oils are drawn off, the high oils to a separate tester on the control floor, and the low oils to the decanter for separation and disposal. It is on the relative amounts of these byproducts drawn off, that mainly decides the quality of the final spirit. In the case of type *1*, a total of some 25% of these might have to be drawn off, and some 10–15% for types *2* and *3*.

The remaining heads and other low boiling vapours pass to the heads concentration column, through the reflux condenser, etc., and finally to separate testers. Hot feints from the rectifier base are pumped either to the analyser or purifier columns depending on circumstances.

The spirit draw-off for type *1* would be located between the 50th and 55th plate of the rectifier, the spirit passing through a cooler to the main spirit tester. Type *2* spirit might be drawn off at about the 40th plate.

For type *3* operation (see Fig. 2), the rectifying column is isolated. The preheated wash is fed to the analyser column and the vapours from here pass direct to the purifying column and heads concentration column which, in this case, acts as a rectifying column. Again varying degrees of spirit flavour and strength are obtainable, according to the amount of regulation of the reflux and spirit draw-off.

It can, therefore, be readily seen that by careful manipulation and control of such a plant, the permutations and combinations of spirit or rum types are really inexhaustible.

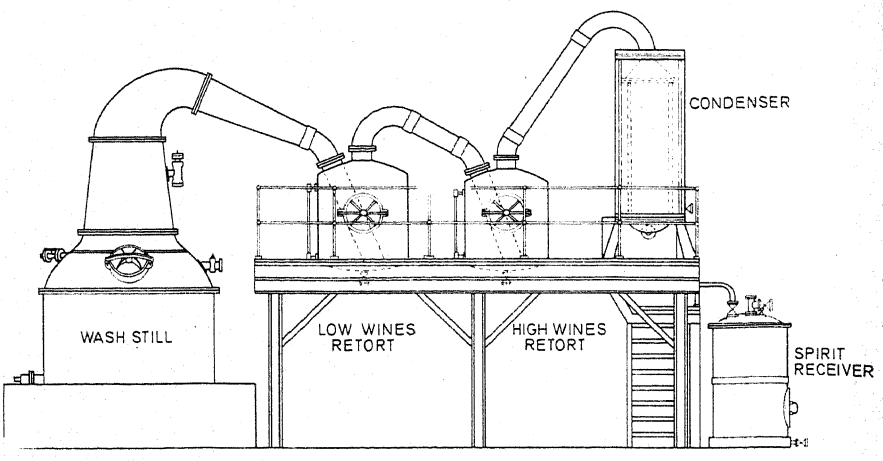

Fig. 3. A typical pot still

Pot-still distillation

Until the introduction of the early two-column type continuous stills into the Caribbean during the latter half of the 19th century, all rum was distilled in pot stills. These stills varied in size, design and materials as also did their mode of operation.

In Jamaica, for instance, a pot still usually consisted of a copper wash still of 500–2,000 gal connected by a swan neck to a copper low wines still, in turn connected to a high wines retort. Low wines are the initial distillate from the wash still, and the further concentration of these, which on distillation by the incoming low wine vapours, issues from the condenser of the high wines retort as rum. During the distillation process on a pot still, only the middle run is taken from the test cases, the initial low wines and final high wines (heads and tails) being separated as fractions and used for the next distillation in their respective vessels. This ensures a reasonable high strength of product and a continuity of quality. In many cases Dunder was added to the wash. Dunder is the lees of previous distillations which had been allowed to age and ripen by bacterial action, etc., to varying degrees. This very strong-smelling liquid, high in acid and ester content, when added to the wash, caused the resulting distillate to have a very rich and fruity aroma, which for many years was a characteristic much sought after in Jamaican rums, and in many specialised markets still has a demand today.

In Guyana (Demerara in the rum trade) also responsible in the past for large quantities of pot-still rum (in this case the darker and heavier Navy-type rums), the process was much the same but differed essentially in that the still pots were made of wood called vat stills, and that Dunder was not used.

The use of vat stills is purely historical, Guyana having two local woods ideally suited for this purpose, namely greenheart for the structural timbers, and wallaba, for the staves. Both the wash still and low wines still might be vats of 3,000–4,000 gal. All connecting swan necks, pipes and condensers were of imported copper. Peculiar to Demerara was the addition above the high wines vat of a tubular copper rectifier, which allowed for rectification of the product to a strength comparable to that of Jamaican rum, i.e. about 40 o.p. (Sykes).

To this day vat stills are used in Guyana, thus maintaining the tradition and the quality of Demerara rums, still a much favoured blending rum with the lighter continuous rums for international brands of Demerara rum. In both cases, there were, and still are, many various methods adopted for distilling these rums. Fig. 3 indicates the main principles of pot distillation of rum in Jamaica or Guyana or elsewhere.

Flavour, bouquet and maturation

In the very early days of rum distillation, when all rums were of the pot-still type and thus heavily laden with relatively large quantities of the byproducts of fermentation and distillation, such as aldehydes, acids, high alcohols, esters, etc., it soon became apparent by trial and error that if these rums were stored in wooden casks for some time they became much more mellow and palatable. This is due to the fact that storing in wood allows oxidation of the many compounds in spirits which give their fine taste.

This fact was also accepted in the Scotch whisky and French brandy trade. However, in the 18th and 19th centuries, it was up to the individual merchant as to whether he matured his spirits before sale to the public. While much rum was drunk straight from the still and would have been a very hot firey liquid, the wiser merchants of England would mature their rums by storing them in wooden casks. Even after the second world war, many pot-still rums, i.e. both Jamaica and Demerara, were sold only when they had matured for five or six years. With heavier Demerara pot and Jamaican Plummer or Wederbarn pot-still rums the ageing period could be as much as 10–12 years.

UK regulations stipulate that all spirits such as whisky, rum and brandy should be matured or held in a warehouse for a minimum period of three years before consumption.

Since then, and with the vast increase in the manufacture and sale of the light continuous-still rums, this situation no longer exists. Now exceedingly light dry rums with a very low chemical components content, have to undergo the legal maturation period of three years when, in fact, it is known by experience, that these rums are ready for consumption after maturation in oak casks for a period of 15–18 months. Thus it appears that a situation has arisen where technology and changing tastes have outgrown the basic reasons for a law made 60 years ago.

In many countries where there are no legal maturation requirements, the very lightest rums are drunk at anything from six months onwards. The cheaper types

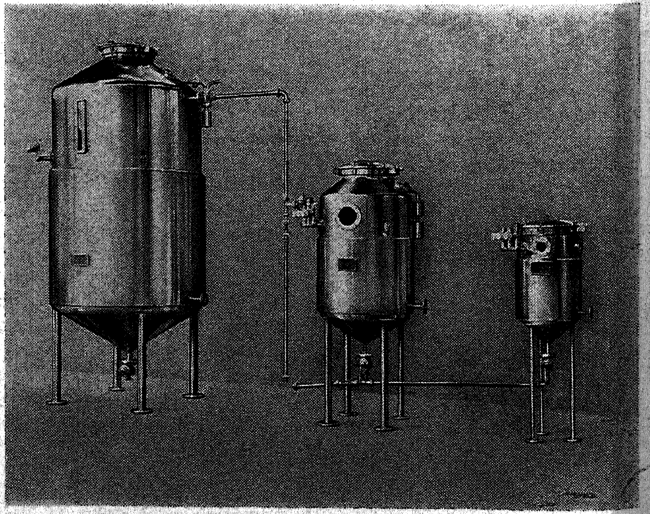

Fig. 4. Tropical yeast culture plant

Table 1. The chemical analysis of pot-still, medium continuous-still and very light continuous-still rums

Pot-still rums		*Medium continuous rums*		*Very light continuous rums*	
	Absolute alcohol samples ex-still (mg/100 ml)		*Absolute alcohol samples ex-still (mg/100 ml)*		*Absolute alcohol samples ex-still (mg/100 ml)*
Demerara		*Demerara*		*Demerara*	
Esters	24·3	Esters	9·5	Esters	1·1
Aldehydes ..	18·1	Aldehydes ..	4·0	Aldehydes ..	0·4
Higher alcohols ..	363·0	Higher alcohols ..	84·5	Higher alcohols ..	3·7
Jamaica		*Jamaica*		*Jamaica*	
Esters	120·0	Esters	49·0	Esters	4·1
Aldehydes ..	16·0	Aldehydes ..	32·1	Aldehydes ..	0·4
Higher alcohols ..	290·0	Higher alcohols ..	117·0	Higher alcohols ..	1·1

are, to a certain extent, still sold as cheap spirits (type 2 above). In view of the considerable cost and negligent result of this statutory maturation period for the lightest rums in this country, there is now a very strong lobby to the government for a reduction in the maturation period to one or two years, as is the case of many overseas countries.

These arguments can, perhaps, be more readily made when one looks at the analysis of typical rums and reasons why they require maturation. For simplification, three types of rum, which have been discussed earlier, have been taken. These are: pot-still rum, medium continuous-still rum, and very light continuous-still rum.

The values shown in Table 1 illustrate the great chemical differences of individual rums and their need for individual treatment and processing prior to consumption. It is readily seen from Table 1, that the pot-still rums need a considerably longer period of ageing to make them palatable.

Many methods have been tried other than the old tried and tested methods of the use of oak barrels, but none have yet ever been accepted legally or have really proved efficient. Today, most light rums are matured for periods of up to two or three years, depending on commercial and legal requirements. The lightest and most fragrant rums, will not increase their palatability, or fragrance in wood, after a minimum time of one to two years, but will tend to become woody.

Carbohydrate Composition of Malt

(Concluded from page 39)

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Microbial Transformations of Antibiotics

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