# The Manufacture of Rum

## *Part 1*

### *Selection of Yeast and Raw Materials . . Treatment of the Raw Materials*

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THE factors influencing the manufacture of a good rum are many and varied, but none plays such an important role as the intelligent selection of the most appropriate yeast strain in relation to the required characteristics sought in the finished product. Any yeast capable of inducing alcoholic fermentation in cane juice or molasses is not necessarily a rum yeast. Lack of appreciation of this basic principle of adequate yeast selection has led to the manufacture of many rums (or so-called rums) of inferior quality. Rum yeasts especially adaptable to genuine rum fermentation may be isolated from the rind of the sugar cane itself, or from some of the products obtained during the process of sugar manufacture, especially from blackstrap molasses. The efforts of most distillers to produce genuine rums using wine yeasts, baker's yeasts or brewery yeasts will never meet with true success.

In every case the rum distiller should use the strain of rum yeast most suitable to produce the type of rum he wishes to manufacture. Hence, selection must go on, even among rum yeasts themselves. For instance, for heavy bodied, strongly scented rums of the Jamaican export types, a top-fermenting, fission yeast would probably give best results; while for light-bodied, weakly aromatic rums of the Cuban or Puerto Rican types, a quick fermenting, bottom budding yeast will best answer conditions. Whatever the type of yeast selected, it must be used in pure culture, (excepting in certain fermentations of the Jamaica types where symbiotic action of two or more fermentation agents may become necessary) and this culture must be maintained pure during all the time it is kept in use for the production of a specific type of rum. Otherwise it would become impossible to produce a standard product invariable in body, taste, and aroma. Besides, unless pure cultures are used, the yields will always be low, variable, and uncertain. Even in the cases where symbiotic action is deemed necessary, the different organisms used must proceed from pure individual cultures, and must be brought together under carefully controlled conditions.

Rum is thus produced through the fermenting action of rum yeasts on the constituents of cane juice, various products of cane juice such as cane syrup, various classes of cane molasses, and mixtures of these different products. But the main source of raw material is that form of cane molasses commonly known as "final" or "blackstrap" molasses. There has been a great deal of discussion whether cane juice or molasses is the best material for rum production. Our experience indicates that a good rum may be produced from either; but that in general, cane juice is more suitable for light types of rum and cane molasses for the heavy types. Of course there are means, through yeast selection, to produce a light rum from cane molasses and a heavy rum from cane juice; but the above statement holds in a general way. Cane molasses in the form of "blackstrap" possesses, nevertheless, decided advantages over sugar cane juice as a raw material for rum production. These advantages exist both from economic and industrial view points; and may be enumerated as follows: (1) For the same amount of money invested in raw material we can produce 2.5 times more rum in the case of molasses than in the case of sugar cane juice. In other words, from the standpoint of yield of rum alone, cane molasses (blackstrap) results 2.5 times cheaper than cane juice for the same amount of sugars acquired in each case. (2) The milling equipment necessary to extract the juice from the sugar cane is dispensed with when producing molasses rum. (3) Storage of cane molasses is a comparatively simple matter, due to its high keeping qualities and concentrated condition. This is not the case with cane juice. (4) The processing is easier in the case of cane molasses from a bacteriological standpoint, since the material is available in a partially sterilized condition on account of the heating processes through which it passes during sugar manufacture. In fact, bacteriological counts made on both of these raw materials have shown cane juice to be, on the average, from 5 to 10 times more contaminated than cane molasses. (5) While high quality molasses may be had and stored for long time use, this is not the case with sugar cane juice. After the season for cane harvest is over it becomes very difficult to obtain ripe and first class canes for juice extraction. (6) Puerto Rican practice has shown that it costs from 18 to 25 cents to produce a proof gallon of raw rum when using cane juice as the raw material, against 9 cents when this raw material is blackstrap.

Accepting then that sugar cane final molasses (blackstrap) is the ideal raw material for rum manufacture, we must consider the factors that enter into its selection for use in rum distilleries. A careful survey of the final molasses produced by sugar factories of Puerto Rico was made by the writer, the results showing that great differences in the relative chemical compositions of individual samples may be noticed. This is especially true in total sugar content expressed as invert sugars, soluble solids non-sugars, total nitrogen content, ash, gums, titratable acidities, pH values, and natural aroma. Great differences were also found in the ratios of true sucrose to invert sugar and total sugars to ash content. Fermentation tests conducted under similar conditions as to fermenting

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agent, temperature, sugar concentration, etc., on these different molasses demonstrated that those possessing low viscosity, high total sugars, nitrogen and phosphoric acid, and that were also low in ash and gums content, were the most suitable for rum manufacture. The qualities of high specific gravity and aromatic natural odor are also very desirable in molasses intended for rum production. Fresh molasses, taken directly from the centrifugal well in the sugar house, always produce better fermentation results than old molasses of long standing in storage; the resulting rums are also of better taste and aroma.

Here lies one of the main reasons why molasses rum distilleries in the continental United States have so much more difficulty and labor in manufacturing a good rum. Practically no selection is made in the purchase of their raw material, molasses being obtained indiscriminately from large local dealers who almost always have a mixed product, sometimes many weeks or even months old, and highly caramelized by the many heat treatments it has undergone to facilitate pumping operations from one place to another. A greater source of trouble is introduced by continental distillers in mixing blackstrap from sugar refineries with that from raw sugar factories. This practice greatly impairs the total yield of rum, and that which is produced will not have the high qualities and distinctive characteristics of a first class rum. As illustration of what constitutes a good, a fair, and a poor grade of blackstrap for rum production the analyses of a sample of each kind will be found below:

| | Good | Fair | Poor |
|---|---|---|---|
| Brix ..... | 87.60 | 85.40 | 84.20 |
| Total sugars (as invert) ..... | 57.97 | 52.91 | 49.93 |
| True sucrose .... | 36.44 | 31.30 | 34.61 |
| Invert sugars ... | 19.61 | 19.96 | 13.50 |
| Ash ..... | 7.31 | 8.35 | 10.57 |
| Nitrogen (total). | 1.15 | 0.72 | 0.44 |
| Gums ..... | 2.09 | 2.54 | 3.51 |
| pH value ..... | 5.80 | 5.68 | 5.10 |
| Natural aroma by steam distillation | Good | Indifferent | Bad |

High total sugars and nitrogen combined with low ash and gums means easy and quick fermenting qualities, with high yields of rum; while high ash and gums combined with low total sugars results in laborious fermentation, especially towards the finishing stages, poor yields, and inferior quality in the finished product. Whatever raw material is selected for rum manufacture, certain pre-treatment of this raw material is always convenient, and sometimes necessary for best results. Especially in the manufacture of rum from cane juice, this pre-treatment is essential if good yields of a high quality product is the end in view. The time for this pre-treatment is just prior to mashing operations.

The pre-mashing treatment of the raw material has two main objectives: (1) partial or complete sterilization of the substrate; (2) preparation of the substrate for the development of fine aroma during fermentation. The first objective is secured through the application of heat at predetermined temperatures; for attaining the second the raw material is subjected to the action of heat and an alkaline agent such as calcium or magnesium hydroxide in the form of the respective milks. Milk of lime as used in sugar manufacture answers the purpose quite satisfactorily.

In rum manufacture complete sterilization of the mash before inoculation is unnecessary and even inconvenient; but a partial sterilization of the raw material is most desirable. Partial sterilization is simpler, less expensive, less perilous, and lies within the means of all distillers, large or small. Moreover, the chemical treatment mentioned above may be applied simultaneously with the partial sterilization process. The necessary equipment for conducting these operations consists of an iron or wooden tank open to atmospheric pressure, provided with heating and cooling devices, a good stirrer, and a thermometer reading in the Centigrade scale. Where blackstrap is the raw material in use, the operation is carried out as follows: An amount of water twice as great (by weight) as that of the molasses in question is poured into the tank, the heat is turned on and the stirrer set in motion. When the temperature of this water reaches 80° C. the pouring of the molasses begins, slowly, and with continuous stirring. When all of the molasses has been thus added to the tank and a completely homogenous mixture with the hot water has been obtained, a sample is drawn, and, after cooling it to room temperature, its pH value is determined by means of a pH apparatus. This pH will usually lie within the range 5.0 to 6.0. In all cases when this initial pH reading is less than 5.8, milk of lime is incorporated to the molasses water mixture little by little until a reading of or very close to 5.8 is obtained. Further addition of the milk of lime is then stopped, but the heating to 80° C. is maintained for 10 additional minutes after the pH reading of 5.8 is obtained, the stirrer being kept going all this time. After this another pH reading is made to corroborate the last one taken. Any alteration in the pH that may have occurred during this time is readjusted to the value pH = 5.8. When the initial pH value of the molasses-water mixture is above 5.8, enough milk of lime is added so as to secure an increase of from 0.2 to 0.3 pH over the initial value, and then this pH value is adjusted by means of dilute mineral acid, or preferably, tartaric acid, to the value 5.8 pH.

The above mentioned treatment greatly benefits the raw material both from a bacteriological and a chemical standpoint. Through the application of heat at 80° C. during the time taken by the operation, the microbiological flora of the mixture is considerably reduced; in fact, all vegetative forms will have been eliminated, only spore forms highly heat-resistant surviving. This will greatly facilitate the subsequent work of the pure yeast culture that will be employed later on during the fermentation stage, with the result that large yields of rum of characteristic agreeable aroma and good taste will be obtained during distillation. The chemical treatment, as stated before, will bring certain changes in the composition of the molasses that prepare it for the formation of the right kind of aromatic bodies during fermentation, and in the case of certain yeast races, the fine aromatic essential oil known as rum-oil is also produced. This phenomenon is especially characteristic in the manufacture of rums of the Jamaica type. We must impress the fact, however, that this chemical treatment, although of great value, may become detrimental if not conducted with the utmost exactitute and care. If the action of the milk of lime is carried beyond the limits prescribed by the pH values given

*(Continued on page 34)*

Trade Association stating that, "This office will not disapprove of New Orleans quotations for Louisiana raw sugar made in accordance with formula for weekly cane settlement purposes contained in Sugar Division telegram of even date." Up to this writing no spot sales of Louisiana raw sugar have been recorded in New Orleans. This is because so much of the crop has been sold on an average price basis and producers who are in a position to sell on the spot market prefer to wait until it has been definitely shown that the Office of Price Administration intends to stand pat on the present ceiling levels.

The A.A.A. office in Baton Rouge has informed Louisiana cane farmers that they will receive no benefit payments this year on excess acreage cane, although they will be allowed to harvest as much cane as they have and sell it to the mills for processing into sugar. G. J. Durbin, administrative officer in charge, informed the growers on October 29 that even though the limitation on acreage for sugar was removed by the revision of the 1941 proportionate share determination, the revised determination does not alter the basis for 1941 crop payments in effect prior to its issuance. The 1941 crop payment to Louisiana growers who harvest acreage in excess of proportionate shares established under the original 1941 share determination, issued November 29, 1941, will be limited this year to 93 per cent of such proportionate shares.

Minimum wage rates for persons employed in harvesting sugar cane in Louisiana for the 1941-42 crop were announced October 1 by the A.A.A. office in Baton Rouge. Time rates are fixed as follows: For cutting, topping and stripping cane, adult male workers, not less than $1.65 per 9 hour day or 18.5 cents per hour; adult female workers, not less than $1.30 per 9 hour day or 14.5 cents per hour; for loading cane, not less than $2.00 per 9 hour day or 22.5 cents per hour; for cutting and loading cane as a combined operation, not less than $1.75 per 9 hour day or 19.5 cents per hour.

Tonnage rates for green sugar cane are not less than 71 cents per ton for topping, cutting, and stripping, 17 cents for loading, and 88 cents for cutting and loading cane varieties Co. 290, C.P. 29-103, or C.P. 29-116; and not less than 82 cents per ton for cutting, topping, and stripping, 22 cents for loading, and 1.04 cents for cutting and loading all other varieties. For burnt cane the rates are not less than 55 cents per ton for cutting, topping, and stripping, 17 cents per ton for loading, and 72 cents per ton for cutting and loading varieties Co. 290, C.P. 29-103, and C.P. 29-116; and not less than 60 cents per ton for cutting, topping and stripping, 22 cents per ton for loading, and 82 cents per ton for cutting and loading all other varieties. These rates are approximately 10 percent higher than those that prevailed last season.

As there have been no spot sales of Louisiana raws, the 3.48 cent price has prevailed since the start of the season. Prices on blackstrap molasses have advanced to 13¾ cents a gallon, in bulk, f.o.b. plantation, and the market is very strong. Receipts of foreign sugar at New Orleans since last report consisted of 162,190 bags of Cubas and 43,671 bags of Perus, to American; 68,951 bags of Cubas, to Henderson; 46,018 bags of Cubas, to Godchaux; and 8,001 bags, to Supreme.

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*(Continued from page 27)*

above, it is possible to have liberation of organic bases or bodies of alkaloid nature. These bodies will later pass (at least the volatile ones) with the raw rum during the distillation of the fermented mash, imparting undesirable odors to it.

The necessity of this pre-treatment becomes more urgent when cane juice is substituted for molasses as the raw material, for it is well known that cane juice represents a raw material possessing a microbiological contamination five to ten times greater than that of final molasses. Besides, it is very difficult to obtain the development of fine bouquet in raw rums made from raw cane juice; while treated juice is an exceptionally good raw material for the production of rums with the right aroma. The accompanying table will present data obtained on three raw rums distilled from cane juice, and show the differences originating from different treatment of the raw material. These differences refer to time taken for complete fermentation, yields on total sugars obtained, and results of organoleptic tests on taste and bouquet. The same sugar cane juice was used in all cases, and mashing, fermentation, and distillation conditions were kept as similar as feasible. Only the pre-treatment of the raw material was varied as shown in the table.

| Pre-treatment of raw juice | Ferm. time, hours | Yield on total sugars | Organoleptic Tests | | |
|---|---|---|---|---|---|
| | | | Taste | Aroma | Persistence |
| (1) | 120 | 38.66 | Passable | Fair | Slight |
| (2) | 70 | 43.05 | Fair | Good | Fair |
| (3) | 60 | 43.77 | Very good | Excellent | Good |

(2) Heat treatment as previously described. (3) Complete treatment; i. e., heat plus chemical, as described.

## Bellingham Factory Sold

The Utah-Idaho Sugar Company has sold the machinery from its idle factory at Bellingham, Washington, to the Remolacheras y Azucareras de Uruguay. It is understood that it will be used to equip a beet sugar factory near Montevideo.