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COVER: Cane Cutters at Work in Hawaii.
Philip Gendreau Photo.

High-Alcohol Beers in Rum Fermentation

Their Use as a Means of Bringing About Higher Production Efficiencies Without Addition of New Equipment

By Rafael Arroyo, Ch.E., S.E.

LACK of proper knowledge in rum fermentation has hitherto produced beers of very low alcoholic concentrations in most rum distilleries, especially when blackstrap molasses has been the raw material used. The problem of low alcohol content in beers is by far more characteristic of rum than of industrial alcohol distilleries and the reasons for this are the following: (1) Rum distilleries are generally lacking in the proper, efficient personnel and equipment found in industrial alcohol producing units. (2) Yeast selection practices are practically unknown in most rum distilleries. The writer has no knowledge of any rum distillery employing the services of an experienced bacteriologist or fermentation specialist. (3) At least in Puerto Rico, it has been only within the last three years that distillers have realized the need of a control laboratory and chemist. Even at the time of writing, there are only three distilleries on the island equipped with a laboratory and control chemist. (4) True, judicious, and systematic research at the rum distillery remains till now a feature of the future. (5) The ready market available, and the very high economic reward obtained at present for commercial rums, are factors contributing in no small measure to check progress in scientific control and the use of improved manufacturing processes at the distilleries. These factors tend to create lack of interest in checking manufacturing losses, improving processes or machinery, or in any other manner tending to improve the general economy of production. In view of the enormous profits available, these other considerations are regarded by the rum manufacturers as matters of little importance.

The result has been that while industrial alcohol plants are obtaining at present alcoholic concentrations in beers ranging from 8.0 to 10.0 percent by volume, accompanied by fermentation efficiencies between 85.0 and 90.0 percent, most rum distilleries are satisfied to obtain beers of from 5.0 to 7.0 percent alcohol by volume, and fermentation efficiencies ranging from 65.0 to 80.0 percent. While industrial alcohol distilleries obtain from 80 to 85 proof gallons of spirit per 100 gallons of blackstrap of average total sugars content, the rum distiller feels satisfied when obtaining from 55 to 70 proof gallons of rum from the same amount of the same quality molasses. High prices paid for rum more than compensate for these deficiencies and losses of manufacture. But since the entrance of the United States into the present world conflict, the rum industry of Puerto Rico has been affected in many ways, advantageously and disadvantageously. It is not the purpose to enter into a thorough discussion of just how the industry has been affected by the entrance of the United States into the war, since that is beyond the scope of this article; but the fact must be mentioned that were it not for the great difficulties encountered in obtaining indispensable equipment, our rum distilleries could, and would, have doubled or trebled their production capacity; since both local and continental United States demands for the product are at their highest peak.

This situation has led to the development very recently of processes aiming to increase production at a given distillery without the employment of additional machinery or other equipment. According to our views and experience in rum manufacture, there exists no easier and better method of accomplishing this increase in productive capacity than by the raising of the alcoholic concentration of the beers during their fermentation. In fact, we already have doubled the output of three Puerto Rico distilleries through this technique. But this is by no means the only advantage gained by a rum distillery when the alcoholic concentration of its beers is appreciably increased without injuring the fermentation efficiency. Let us consider how this simple raising of the alcoholic concentration in the beers affects the rum distillery: (1) The most obvious result is, as already stated, the great increase in productive capacity. (2) The increased production brings about a corresponding decrease in manufacturing costs based on unit proof gallon. This economy in production is manifested in (a) labor cost; (b) overhead expenses; (c) fuel bill. (3) A less tangible advantage results from the fact that fermentation failures are practically eliminated in the fermenting room. This is accomplished by the greater antiseptic action produced within the fermenting mash by the development of the high alcoholic concentrations. The writer is acquainted with the case of a small distillery equipped with wooden fermenters, which when working originally with beers of about 5.50% alcohol by volume, had frequent and numerous fermentation failures, due to bacterial infection that could easily develop and flourish in the weakly alcoholic media. As soon as this distillery adopted the practice of producing high alcoholic concentration beers, the failure of fermenters stopped, and since that time not a single case has occurred. (4) Esterification, both during fermentation and distillation, takes place more readily when producing high-alcohol beers. This helps in the very important matter of rum flavor and aroma in the raw spirit obtained. (5) The still is kept clean for a longer period of time when high-alcohol beers are distilled. This is due to the fact that the

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High Alcohol Beers

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beer entering the still holds less solid impurities in suspension and solution that may cause incrustations and deposits on the plates of the column. (6) The steam economy during distillation, based on unit proof gallon produced, comes from four different causes: (a) less water needs be heated and evaporated; (b) the boiling point of the high alcohol beers is lower; (c) less refluxing becomes necessary in order to secure a predetermined proof in the distillate; (d) the efficiency of the still is kept at its best for a longer period of service due to low rate of fouling of plates and column. (7) Another advantage is that a less amount of slops is produced per proof gallon of rum manufactured. This is a definite gain when the delicate matter of slops disposal arises.

Of all these advantages derived from the use of high alcohol beers, the greatest and most significant is that of increased production without the need of new installations of either fermenters or stills. This becomes particularly important in time of war when new equipment is practically out of reach. The writer is acquainted with the case of a rum distillery whose very existence as a going business was saved through the substitution of 5.0 to 6.0 percent alcohol beers by 11.0 to 12.0 percent ones. Incidentally this small distillery has, in the course of time, become a sort of yardstick of rum distillery efficiency and high production. It is at present steadily producing beers of from 11.0 to 12.0 percent alcohol by volume, with a fermentation efficiency running between 90.0 and 95.0 percent. This is considered a record breaking feat, not only for Puerto Rico, but for any other rum producing country. In Table I will be found the result obtained at this distillery during one week of operation.

TABLE I

Showing the average results obtained during one week operation under high alcohol beers technique, by small rum distillery in Puerto Rico

A. MASHING	
Molasses used, gals.	6,980.000
Molasses used, lbs.	84,039.000
Total invert sugars used, lbs.	49,284.000
Average Brix of molasses	88.000
Total sugars, % by weight	58.600
Average Brix of mash	29.040
Total sugars in 100 ml. mash, grs.	20.714
B. FERMENTATION	
Total volume of beer, gals.	28,090.000
Alcohol in beer, % by volume	11.550
P. G. rum per 100 gals. beer	23.100
P. G. rum per 100 gals. molasses	93.000
Yield alcohol on weight of total sugars	44.054
Fermentation efficiency, %	90.740
C. DISTILLATION AND YIELD	
Total proof gallons produced	6,292.000
Daily production rate	1,200.000
Distillation efficiency, %	96.96
P. G. rum per lb. invert sugars	0.128
P. G. rum per gal. molasses	0.902

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Sugar Beet Black Root

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roots form and the plant recovers. The fungus may be carried on the seed or live from season to season in the soil. The conditions for Phoma infection are quite general. Its temperature range is quite broad, though losses do not seem to be as heavy in cool soils as in moderately warm soils. The effects of other soil factors are discussed further on.

(*To be continued*)

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