A NEW RUM DISTILLATION PROCESS

A System of Fractional Distillation by Which Rums May Be Obtained of Specific and Predetermined Chemical Composition

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RAW rum represents a mixture of three essential parts: (1) ethyl alcohol; (2) water; and (3) the non-alcohol number, also called the non-alcohol coefficient or coefficient of impurities. Ethyl alcohol is the constituent found in the largest proportion, and characterizes the distillate as an alcoholic one; water ranks second in amount, and exists as a diluent in very variable proportions according to the degree proof at which the raw rum is distilled; and the non-alcohol number, while being the least important in magnitude, is really the one that gives the distillate its peculiar characteristic as rum. Raw rum deprived of its non-alcohol number ceases to be rum and becomes a simple mixture of ethyl alcohol and water.

The non-alcohol number of raw rum is of a very complex nature from a chemical viewpoint, being formed by many and varied groups of aromatic and flavoring compounds. The potential group components, and individual members within each group which have been isolated and classified so far are the following:

A—Acetals: (1) Acetal.

B—Alcohols: (1) Monohydric Saturated: (a) methyl, (b) propyl (normal), (c) isopropyl, (d) butyl (normal), (e) isobutyl, (f) amyl (normal), (g) amyl (secondary), (h) hexyl, (i) heptyl, (j) octyl, (k) decyl; (2) dyhydric alcohols, or glycols: Isobutylglycol; (3) trihydric alcohols: glycerine.

C—Aldehydes: (1) acetaldehyde; (2) propaldehyde; (3) isobutaldehyde; (4.. butaldehyde; (5) hexaldehyde; (6) heptaldehyde; (7) furfural.

D—Ketones: (1) acetone.

E—Organic acids: (1) formic; (2) acetic; (3) propionic; (4) butyric; (5) caproic; (6) heptoic; (7) caprylic; (8) capric.

F—Esters: (1) Acetates of: (a) methyl, (b) ethyl, (c) propyl, (d) butyl, (e) isobutyl, (f) amyl alcohols; (2) Propionates of: (a) methyl (b) ethyl, (c) amyl alcohols; (3) Formates of: (a) ethyl, (b) propyl, (c) butyl, (d) amyl alcohols; (4) Butyrates and isobutyrates of: (a) ethyl, (b) amyl alcohols; (5) Oenanthate, caprylate and caproate of ethyl alcohol.

G—Bases: (1) pyridines; (2) amines.

H—Essential oils—A mixture of natural essential oils very valuable for the rum taste and aroma, of hitherto unknown chemical constitution, but presumably of a terpene nature. Some of these exist as such in the raw materials from whioh the rum is produced, while others are formed during fermentation through the action of the yeast upon certain constituents of the raw materials.

The above list of chemical compounds and group components that have been recognized as potential components of the non-alcohol number of rums, will give an idea of the complex character of this third and most important part of raw rum. Not all of these compounds are actually present in the make-up of the non-alcohol number of a given rum sample, but all of those mentioned or any part thereof are potential components of rum constitution. The existence of additional members is presumed, which have so far eluded isolation and identification by known analytical procedures, due to their inherent unstable characteristics, or to being present in almost infinitesimal amounts. However, they also undoubtedly play a part in the composition of the compound and complex rum taste and odor.

Not all of these constituents possess equal value in the formation of rum flavor and aroma. In fact some are detractors rather than enhancers of rum taste and odor. For instance, some of these constituents possess lower boiling points than ethyl alcohol, and they also possess sharp and irritating odors and tastes. Among these we may mention acetaldehyde, propaldehyde, the formates of ethyl and propyl alcohols, the acetate of methyl alcohol, formic acid, and acetone. Others of these compounds possess higher boiling points than ethyl alcohol, and they also possess qualities of aroma and taste far superior to the members just mentioned above. Among these we may mention ethyl butyrate, amyl formate, ethyl oenanthate, caprilate and caproate; butaldehyde, hexaldehyde, heptaldehyde, and acetal. In addition there is the group of essential oils to which the generic name of "rum oil" has been applied by this writer.

Our researchers on rum have demonstrated that high qualities in organoleptic characteristics of taste and aroma will depend not so much on the total amount of congeneric products present in the non-alcohol number of a given rum, but principally on the kind of congenerics, and in certain ratios and relations that must exist among the various individuals forming group constituents, and among the group constituents themselves. Therefore, improvements in rum distillation leading to the production of better, healthier, and more palatable products must come as a result of a better knowledge and understanding of the chemical constitution of the members of the non-alcohol number and the ways and means of exercising discrimination and selection among the possible potential components of the non-alcohol number during the process of distillation. In other words, for all practical purposes, the distiller must have at his command the means to modify or determine at will the amount and kind of congeneric products he wishes to integrate into the non-alcohol number of his particular rum. The realization of this ideal constitutes scientific rum distillation, and by its use customers will receive exactly what they desire. This is what the distillation method further herein described is designed to accomplish.

Under the present methods of rum distillation there does not exist a safe, reliable procedure for the selection of the right amount and kind of congeneric products, nor for the separation or prevention of the undesirable ones. The result is that most freshly distilled rums contain a mixture of wholesome, cherished constituents, and undesirable, quality-detracting ones. Also, it often happens that when attempting to eliminate the undesirable congeners during distillation some of the most valuable and cherished products are also eliminated; the resulting distillate is characterized by flatness of taste and lack of "bouquet." In other words, such distillates cease to be rums in the true sense and meaning of the word. In a similar manner, under present methods of rum distillation the appropriate ratios and relations among the constituents of the non-alcohol number cannot be maintained, and when obtained, it is only by chance.

There probably does not exist a single rum distillery capable of exactly duplicating the chemical composition of the daily distillate two days in succession. In this situation, means do not exist to guarantee the permanence of rum composition and quality, and a standard product becomes almost a physi-

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cal impossibility. These fluctuations in the chemical composition and organoleptic qualities of the raw rums produced from day to day must necessarily show up later on in the great variations encountered by the consumers in the body, taste and bouquet of the marketed product.

As a cure for deficiencies in distillation techniques and procedures, prolonged aging of the raw rums over long periods of time has been resorted to. While this practice makes up in part (and in part only) for deficient distillation, it offers many disadvantages, losses, and expenses to rum producers. Among these we may mention initial expenses in land, warehouses and barrels; replacement of these barrels and other equipment; handling expenses, alcohol losses, volume losses, and the inactivation of considerable capital over prolonged periods of time. Besides, our researches on this subject have shown that aging of the raw rum in the oak barrel will not convert or transform a poor distillate into a first class marketable product; the rum which is bad at birth remains so (although perhaps with some amelioration) even after reaching old age.

In order to obviate most of the present deficiencies in rum distillation outlined above, and also with the purpose of producing better rums and reducing the cost of production, a new process for rum distillation has been worked out, and a special fractionating still has been designed for the best accomplishment of our objectives, which are: (1) obtaining standard raw rums of well defined and selected chemical composition in their non-alcohol number. (2) Creation of a method of rum distillation whereby the distiller can control at will the characteristics and chemical composition of his raw products. (3) Creation of a method of rum distillation whereby the chemical composition and organoleptic characteristics of the raws may become specific and predetermined in accordance with selected standards. (4) Elimination of the chance factor and the hit-or-miss rule from rum distillatimon. (5) Making possible the obtaining of a variety of classes and types of rums by a single distilling technique. 6() Elimination of excessive alcohol losses during unnecessarily prolonged periods of aging. (7) Cutting down excessive expenses in warehouses, barrels, handling, and general expense in the production of the marketable products, which is done along with a considerable shortening of the time of the aging necessary for the requirement of maturity.

The Process

The process starts with the beer obtained in any of the well known fermentation methods for rum production, for which the writer has already secured patented procedures. The beer is first distilled in a continuous still designed for the production of neutral spirits at a proof of distillation varying between 170 and 189 degrees. The products extracted from this main body of neutral spirits during this first distillation will contain all of the members of the non-alcohol number. The different extractions are combined into one minor volume in a suitable reservoir.

The main volume of neutral spirits will comprise from 85 to 90% of the total distillate obtained during this continuous distillation, while the minor volume will contain a mixture of ethyl alcohol, a little water, and all of the members of the non-alcohol number, the whole mixture amounting to from 10 to 15% of the total distillate obtained during this first distillation.

This minor portion of distillate containing all of the members of the non-alcohol number in a concentrated form is then further diluted with ordinary tap water so as to reduce its proof to within the range 80 - 100 degrees. The diluted mixture of spirits and members of the non-alcohol number is then submitted to fractional distillation in a special batch still, designed for this purpose by the writer. The fractional distillation is carried under ideal dephlegmatory and fractionating action, making use of the principles of fractional condensation through accurate control of the temperature of the injection water used in the reflux condenser of the still. A careful adjustment for the heating of the liquid in the kettle is used. This control of the boiling process is essential to the proper working of fractionation and reflux, and of great importance to the proper and efficient separation of the various constituents of the non-alcohol number without degradation or decomposition by overheating the liquid or vapors. The different members of the non-alcohol number are separated by this second distillation according to their boiling points and molecular weights. Five different fractions are obtained during this fractionation, each one being received in a separate glass-lined steel receiving tank of the closed type. These tanks are calibrated and graduated so that the amount of distillate in each vessel is readily ascertained with precision.

The fractional distillation is carried out in the following manner: the first fraction will pass over at a temperature range of 65 - 72 degrees Centigrade; the second fraction within the range of 72 - 78 degrees; the third at 78 sharp; the fourth is collected as soon as the controlling thermometer reads a few tenths of a degree over the 78-degree mark and is finished when the thermometer reading reaches 84 degrees; and finally the fifth fraction is collected within the range of 84- -98 degrees Centigrade. In this manner the different members of the non-alcohol number, in a mixture with ethyl alcohol and a little water, are collected separately in a series of five receivers, each receiver containing different group components of different chemical composition, the separation of components having been effected in accordance with individual boiling points, molecular weights, and characteristic tendencies of these compounds to form azeotropic mixtures with ethyl alcohol.

When the fractional distillation is finished, the members of the non-alcohol number will be distributed and separated into five diffeernt fractions of different chemical compounds. Most of the undesired constituents will be grouped together in the first fraction, while the fourth fraction will contain the greater part of the fusel oil originally present. Fraction No. 2 will contain medium boiling point aldehydes, esters and organic acids, besides a small amount of the low boiling point ones; the third fraction will consist mainly of ethyl alcohol, a very small amount of acetic acid, and traces of aldehydes and esters; and finally in the fifth fraction there will be found practically all of the valuable essential oils (which are mostly responsible for the peculiar rum aroma) together with very important esters and aldehydes of high boiling points and molecular weights. This fifth fraction is practically devoid of fusel oil, although traces may be found sometimes. It is of rather high organic content, containing in fact more free acidity than fractions two, three and four put together. This is really the most important fraction from the standpoint of rum making, as it contains the most cherished constituents in the formation of genuine rum aroma and taste. But some admixture from the second and fourth fractions becomes necessary in order to bring out the full flavor and aroma of high class rums. With respect to the respective volumes forming each fraction, we have found that fractions (1) and (2) will each contain about 10% of the total distillate; fraction (3) will be the largest, containing about 55 to 60% of the total volume; and fractions (4) and (5) will divide the balance of the total distillate about equally between them.

Having obtained the different fractions with compositions as above described, the first one is usually discarded, the third is mixed with the neutral spirits previously separated during the first continuous distillation (since this third fraction is practically pure ethyl alcohol and water); and the second, fourth and fifth fractions are used for the final formation of the raw rum or rums desired. For this purpose, samples from each one of these fractions are carefully analyzed and their peculiar chemical composition accurately determined. Formulation of the chemical composition of the non-alcohol number of the raw rum to be manufactured may then be decided "a priori" with precision. All that remains then to be done is to combine the main body of neutral spirits and the constituents selected by the distiller for the formation of the rum's non-alcohol number. In this manner a raw rum is formed with a non-alcohol number controlled at will as to quantity, kind of individual components, and the desired ratios and relations that will guarantee a first class product as a raw rum, and a quick maturing one as a finished rum for the market.

Rums thus manufactured under strict scientific and sanitary control represent a guarantee as to quality of taste and aroma, protecting the health of the consumers as well. Other great advantages of this method of rum distillation from an economic viewpoint are the saving of the ethyl alcohol usually lost during present methods of distillation when separating head and tail products, since during fractional distillation most of this alcohol is recovered in the third fraction in almost a pure condition; and also the further saving of alcoholic loss occurring at present during the prolonged aging periods used in maturing the raws. A considerable saving in curing time is obtained by the process of distillation above described, thus also saving in warehouse space and equipment, barrels, labor, etc.

Under present conditions of rum making the prolonged period of aging required for obtaining maturity is mostly due to the defective chemical composition of the rums. The barrel is required to do the work that should have been accomplished during distillation, that is, the elimination through its pores of those non-desirable constituents that were allowed to pass over mixed with the desirable constituents during the defective distillation. Since these undesirable and polluting substances possess the lowest boiling points and smallest molecular size, they will be the first to pass out from the barrel into the surrounding atmosphere, and in this manner purification of the raws takes place slowly in the barrels during aging. But this work of purification is both slow and costly, and may be done to better advantage during distillation. This is just what this new process does in a most effective manner during the fractional distillation stage. Then, when the aging barrel is filled with this new type of raw rum of perfected and controlled chemical composition, the extra work of purification in the barrel no longer needs to be done, and in this manner the aging period is materially reduced.

Hence this new process not only provides a truly scientific and sanitary method of obtaining better and healthier rums, distinctive in taste and aroma, but it also makes possible the more economical production of marketable rums. In this way quality is not enhanced at the expense of higher prices to the consumers. Greater diversity of marketable rums is also assured, so that differences of taste among consumers may easily be provided for by selective extraction of the members of the non-alcohol number of the rums. Although this process of distillation has been specially developed for rum making, it may be equally applied in the case of other distilled beverages, especially whiskey and brandy.

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Union Sugar Company

The Union Sugar Company, of California, reports a net income for the year ended February 28, 1949, of $980,936, equal to $4 a share of capital stock and comparing with 1948 earnings of $800,063, or $3.25 per share. This was the most profitable year the company has had, a record established in spite of a reduced sugar production. Production in 1948-49 was 83,400,000 pounds, compared with 127,000,000 pounds produced in 1947-48. The decrease was due to a combination of smaller beet acreage planted and lower yields of beets and sugar per acre. The 1949 income account shows gross profit from operations of $1,840,677, and net income before federal taxes of $1,555,552. Current assets on February 28 last totaled $2,216,876 against current liabilities of $352,575. Dividends of $1 a share were paid during the year and earned surplus was increased from $1,532,237 to $2,267,436. Income of the company in 1948-49 included $115,901 in oil royalties; there are now 32 producing wells on the company's lands.

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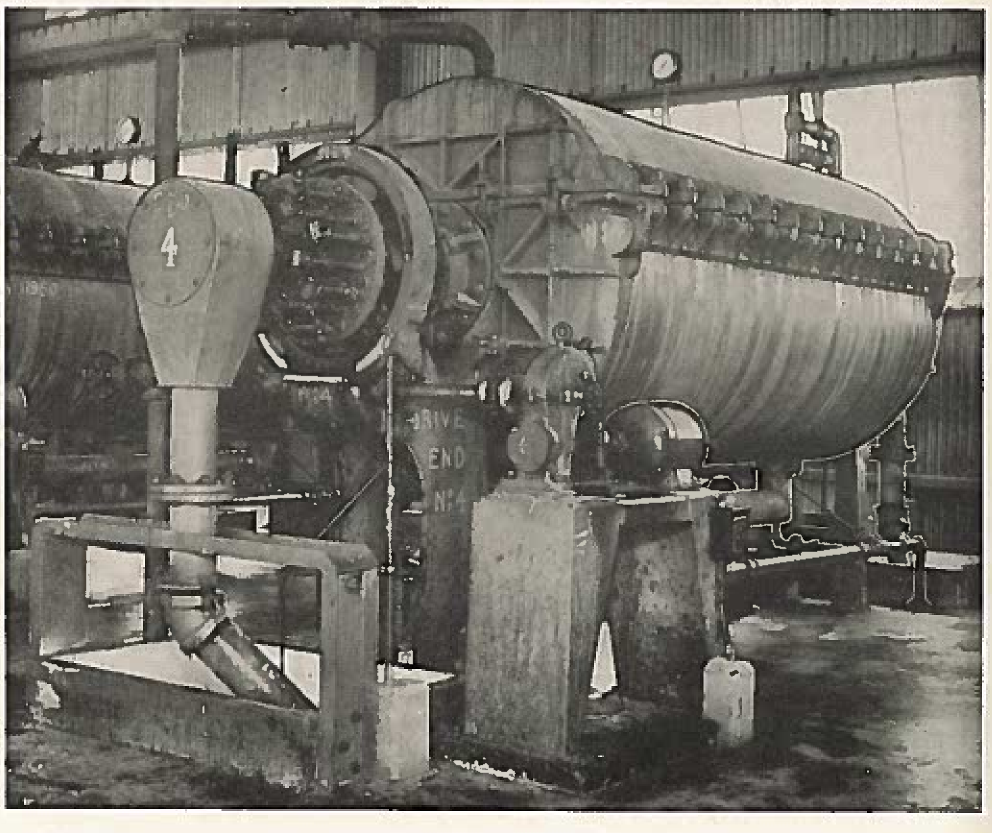
El Potrero Seeks U. S. Market

MEXICO, D.F.—El Potrero central, in Vera Cruz, of which Erich Koenig is general manager, is aiming at the New York market with a shipment of samples of its best sugar, claimed to be the top quality produced in Mexico. The shipment was made on the American freighter Agwistar from the port of Vera Cruz.

Guayalejo—a Correction

In the article published in the May issue of SUGAR about Ingenio Guayalejo, recently completed at Xicotencatl, Mexico, the picture shown herewith was incorrectly labeled, "A Sweetland filter press." The illustration actually shows one of the five "Auto" rotating pressure filters manufactured by the Suchar Engineering and Sales Company for successful operation at Ingenio Guayalejo.



OBSERVA
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