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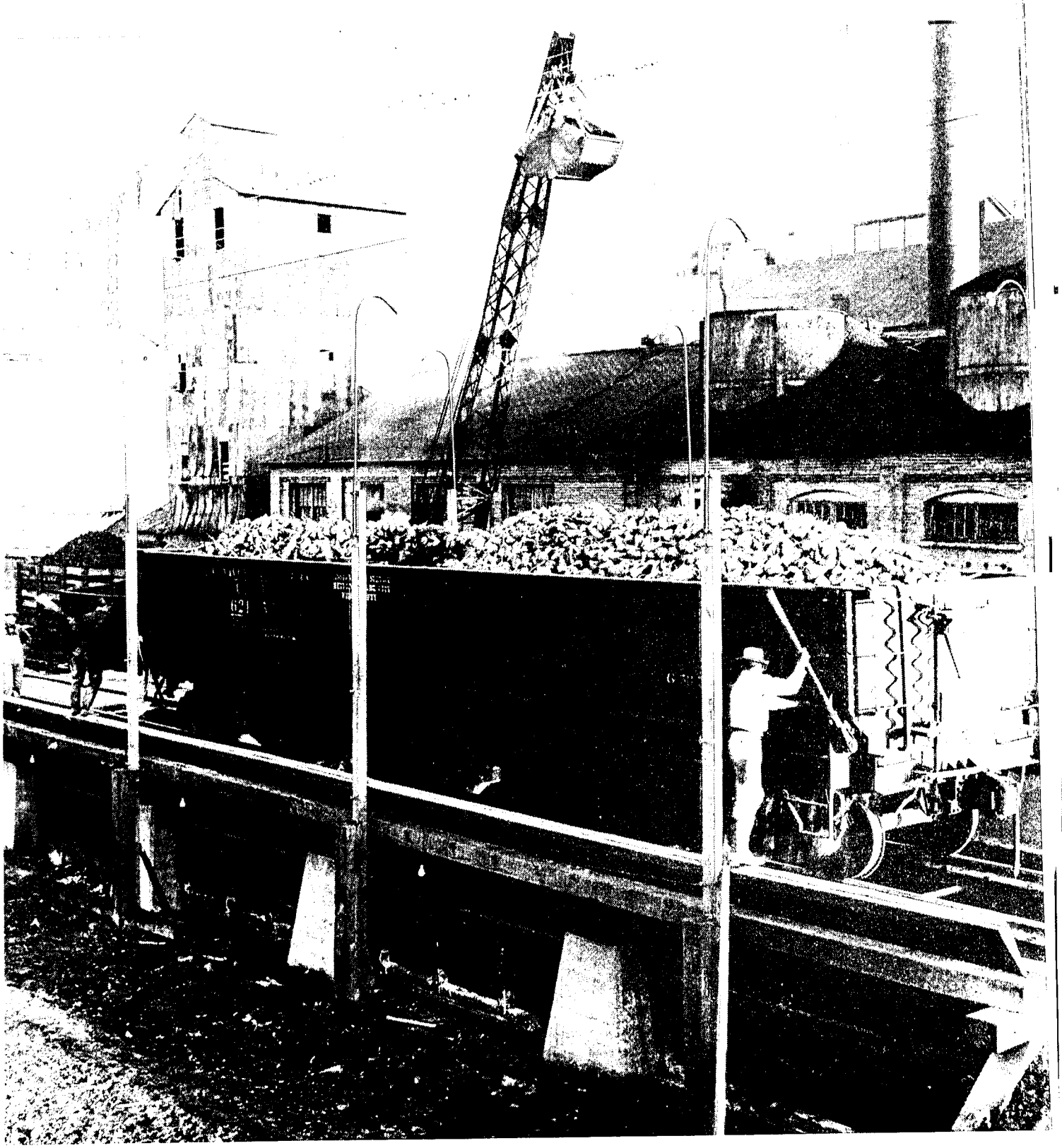

The Production of Heavy Bodied Rum

A Procedure Which Shortens the Time of Fermentation and Aging and Gives High Yields and Fermentation Efficiencies

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

THE so-called heavy rums have usually been differentiated from the more common and better known light rums, by their non-alcohol number and by physical and organoleptic differences of body, taste, and aroma. The heavy rums are the ones preferred in continental Europe, while the light rums are preferred in the United States. With the termination of the war there will be great opportunities for the United States Caribbean possessions to enter into the European rum market, but before the opportunity can be utilized it will become necessary to be able to manufacture heavy rums of the highest quality, conforming to the standards that are required by European importers.

A heavy rum possesses a higher non-alcohol number and a richer and more intense taste and aroma than a light rum. It is also distinguished by a very high index of persistence in both aroma and taste, by which is meant that it can endure high diluting with aqueous solutions of neutral spirits before its characteristic aroma and taste can no longer be perceived by an experienced taster. While the heavy type of rum has been manufactured in the past, and is being produced at present, most of the methods hitherto followed have been of a haphazard or empirical nature, and therefore coupled with uncertainty in execution, with results that frequently have been detrimental to the quality of the finished product and to the economy of the process, or to both. These facts have been evidenced in practice by the much greater consumption of light rums, especially in America. Two main reasons exist for this: (1) the few wholesome, genuine heavy rums on the market are too expensive for the average purchaser; (2) most of the low priced heavy rums on the market are improperly fermented and distilled, or are artificially concocted. For instance, it has been sought to manufacture heavy rums by merely changing the method of distillation as used in the manufacture of light rums, so that more of the so-called head products are allowed to pass over into the main distillate or raw commercial rum. This was thought to increase the non-alcohol number and to add the necessary extra flavor and aroma. These attempts, however, have failed to produce a first class, genuine heavy rum, since what is really accomplished by such procedure is the addition to the main distillate of undesirable congenerics of the alcoholic fermentation, being in fact the same products that are so carefully and painstakingly eliminated when manufacturing the light type of rum. Obviously, a carelessly distilled light rum is not a first class, genuine heavy rum.

It has been found that the presence of certain bacteria in the fermenting alcoholic medium aids in securing flavor and aroma for the resulting rum, and a second prior practice has been to carry the rum fermentation forward in a substrate which was purposely badly infected, and in which all kinds of unidentified bacteria and other microroganisms have competed with the rum yeast strain in the fermentation of the sugars present in the mash. The success or failure of such a method of heavy rum making depends on the kind and extent of the infection present. Even when successful as to the quality of the product, when by chance or luck the right kind of bacteria, and only such, are present as the infecting organisms, this unscientific practice leads to poor results with regard to yields and fermentation efficiencies.

It has been found however, that heavy rums of excellent type and with high yields and fermentation efficiencies can be obtained by a procedure comprising: (1) the subjection of the raw material to a pretreating operation which fits it for its intended use; (2) the selection of yeast and bacterial cultures adapted for symbiotic fermentation of heavy rums; (3) the employment of optimum conditions for the production of alcohol and of the right kind of aroma and flavor; obtaining at the same time rapid fermentations, a high quality product, and high yields and fermentation efficiencies; (4) the employment of a proper and rational distillation method for the resulting beers, founded on the principle of selective rum distillation.

As an illustration of the process, the procedure may start with employment of a blackstrap sugar cane molasses. This blackstrap is pretreated to improve it chemically, physically, and biologically. For this purpose, a cylindrical iron tank is equipped with a thermometer, steam coils, and a motor-driven mechanical stirrer. It is preferred also to connect it to the still condenser outlet, so that hot water from the condenser may be supplied into this pretreatment tank, to afford saving of heat units during the pre-treatment operations. The molasses is brought into the pretreating tank and mixed with a predetermined amount of milk of lime which is calculated to raise the pH value of the molasses by 0.5 pH; the actual amount to be employed for treating the introduced weight of molasses is determined experimentally according to the density and original pH of the raw material, and the amount treated per batch. After introducing the milk of lime the stirrer is set in motion and hot water from the still condenser is added, with vigorous stirring, until the resulting mixture attains a density that may vary in practice between 55° and 65° Brix, proferably 60 for normal Puerto Rican molasses. The hot water is then shut off and the temperature of the mixture adjusted by introducing steam into the coils, so that a temperature beween 70° and 80° Centigrade is attained; this temperature is then maintained in the resulting thick mash from 15 minutes to one hour, depending upon the purity of the molasses, the equipment available, and the schedule of operation. The molasses mixture, or thick mash, must remain below pH 7.0; that is, it is less acid but not definitely alklaine during this pre-treatment.

While still strongly agitated, the mixture is next passed through a separating device, such as a centrifuge of special construction, or preferably, a self-cleaning sperm-centrifuge, for the separation of solid organic and inorganic impurities which have been precipitated or separated during the alkaline and heat treatment described. The clean run-off, in the form of a thin mash, is then delivered into a second pretreatment tank which is equipped like the first one, except that this time the coils are connected for water cooling. As soon as the coils are covered by the inflowing thick mash, cold water is introduced through them, and the agitation of the mass is continued during the entire cooling period. When the temperature has dropped to about 45° to 40° Centigrade, enough strong sulphuric acid is added to the tank contents to obtain a new pH value of between 5.0 and 5.2. Then there is added enough strong ammonia water of 26% to 29% strength so that a final pH of 5.4 to 5.6 is obtained in the contents of the tank. Finally there is added 0.5% of ammonium sulphate and 0.1% of calcium superphosphate on the weight of the molasses mashed. The

m for symbiotic working of the yeast l bacteria lies at around pH 5.5 for the duction of heavy rums; and it is prefer- to observe this throughout, both for plicity of control and for avoiding shock the organisms when they are brought ether. The mash is then passed through econd filter or supercentrifuge for the aration of newly precipitated solid im- ities obtained during the acidification the mash. The cleaned, purified, and ditioned thick mash thus resulting is ivered to a receiving and storage tank, n which it is drawn as needed for mash- operations.

s pre-treatment has eliminated large tions of impurities such as molasses as, ash, infective organisms, and me- nical impurities, by the combined effects temperature conditions and relative al- nities in the several stages, and an in- sion of saccharose has been initiated by son of the final acid treatment. The st strain used should be of a type pted to the fermentation of heavy rums. yeast strains are not suitable for this pose, and not even all varieties of rum sts will serve. The best of these yeasts to be found among the schizo-saccharo- es or fission yeasts, but a few strains budding yeasts may also be employed success. A characteristic of a proper vy rum yeast in accordance with the sent process is that it should be able stand moderate, but appreciable con- rations of organic acids during the holic fermentation, particularly satu- d aliphatic fatty acids such as acetic, ionic, butyric, and others higher up in series. It should be a fair to good pro- er of rum oil. The yeast should also co- ate symbiotically with the bacteria used m auxiliary co-ferment.

yeast strain is prepared to form a ing for the seeding of the fermenters starting propagation every day at the illery laboratory from an agar slant aining a pure culture of the yeast. By wn methods of bacteriological tech- ie, a portion of this pure culture is sferred to a biological test tube con- ing 25 ml. of sterile molasses mash. en this first transfer has reached vigo- fermentation, a new transfer is made a 500 ml. Erlenmayer flask containing it 350 ml. of sterile mash, and such sfers are made in succession as vigo- fermentations occur, until a seed cul- of about five gallons has been built up ie laboratory. This culture is then em- ed as the inoculum of the first vessel he plant yeasting equipment. A co- ative bacterial ferment is also devel- l in the laboratory for introduction into fermenters in due time. It is preferred mploy *Clostridium saccharo butyricum* spore form in sterile soil or sterile "bag- acillo", and is activated into its vegetative form prior to its use for building the re- quired seed. The laboratory seed is de- veloped in essentially the same fashion de- scribed for the yeast seed.

The fermentation of the thick mash is illus- tratively accomplished in a batch procedure by causing the thick mash to flow from the receiving tank into a machine for the prep- aration of thin mash. Here the thick mash is diluted by additional water to the re- quired density. It is important that the density of the thin mash be kept at such a value that the total sugar concentration per 100 ml. shall not exceed 13.0 grams. The thin mashing control is determined by grams of total sugars per 100 ml. of mash rather than by the Brix density. It is desir- able and convenient to maintain the sugar concentration as near as possible to the limit above given, but a lower concentration than 13.0 grams per 100 ml. mash may be employed, if desirable, with a particular molasses, yeast, or bacterium. The maxi- mum initial total sugar concentration of 13.0 grams per 100 ml. has been selected to the benefit of the bacteria, as most bac- teria of the propionic and butyric groups do not tolerate the sugars at much above 6 grams per 100 ml. mash, and are also inhib- ited by alcoholic concentrations of 8 percent by volume, or above. Since 13.0 grams per 100 ml. does not yield over 8 percent by volume of alcohol during fermentation (most probably about 7.0 to 7.5 percent) a safety factor is provided, regardless of the yeast action. And since the total sugars are reduced to about 6.0 grams per 100 ml. at bacterial seeding, the consequent alcohol concentration will not exceed 4 to 5 per- cent by volume, and the bacteria are then able to proceed with their own work in symbiosis.

The fermenter first receives an active, vigorous yeast footing before the thin mash is introduced. This footing should amount to between 5.0 and 15.0 percent, and pre- ferably is about 10.0 percent of the total working volume of the fermenter; as this insures a rapid start of the fermentation without involving the complications inher- ent to the preparation of a very large foot- ing, especially if the fermenter is of large capacity. The fermenters may be of the closed type, constructed of polished iron, or steel, and provided with mash cooling devices and means of agitating the mash, either mechanically or by the admission of carbon dioxide gas at the bottom. This car- bon dioxide may be obtained from another actively going fermenter, or from com- pressed carbon dioxide containers. Agita- tion by means of air is not recommended on account of the detrimental effect of the oxygen upon the anaerobic bacteria. It is temperature and pH. The thin mash is added upon the yeast footing in the fermen- ter, with a gentle stirring or agitation of the contents, so as to provide thorough and even distribution of the seed yeast. When all of the mash has been added, the pH value is noted, and the contents are corrected to a value of 5.5 by the addition of either sulphuric acid or milk of lime, as the case may require. The setting tempera- ture should be between 28° and 31° C.

Fermentation is allowed to proceed un- der temperature control within a range of 30° to 33° Centigrade, preferably by means of cooling coils placed outside of the fer- menters through which the mash may be circulated whenever temperature correc- tion becomes necessary. After the sixth hour of actual fermentation, tests are made for amount of total sugars present in grams per 100 ml. of mash. Likewise, determina- tions of alcoholic concentrations in per- centage by volume are thereafter effected every two hours. When the percentage of alcohol by volume is about 3.5 to 4.5, and the total sugars per 100 ml. of mash have a value of 6.0 grams or less, the conditions are ready for the incorporation of the bac- terial footing into the fermenting mash. The fermenting mash is first corrected to a pH value between 5.4 and 5.6, if neces- sary. The pH value of the bacterial footing is similarly adjusted to essentially the same pH figure, and then, while gently stirring or agitating, the bacterial footing is added to the fermenter in an amount equivalent to 1.0 to 4.0 percent of the total volume of the fermenting liquid. It is preferred to employ 2.0 percent of the bacterial foot- ing when a yeast footing of 10.0 percent has been used under the above conditions, as the ratio 1:5 appears to give an optimum result. The higher the ratio of bacteria to yeast, up to 1:5, the heavier and more aro- matic is the resulting rum, but when the ratio is much higher than 1:5 there is dan- ger of obtaining uneconomically low yields of rum, since the faster propagation of the bacteria will overcome the yeast, limiting or stopping its zymogenic powers.

After the addition of the bacterial inocu- lum, greater care becomes necessary about temperature control, as it is then important that the temperature within the fermenter should not go much above 30° C. Corre- spondingly, the pH value should be so con- trolled that it will never be below 5.0, as at pH values of 4.0 and below the bacterium will lose its activity and go into the spore form. The fermentation is then allowed to proceed to a finish. In case higher alcoholic concentrations than may be expected from the initial amount of sugars concentration in the mash are desired, more sugars may be introduced into the fermenter when the total concentration in the fermenter has

dropped to a value between 1.5 and 2.0 grams per 100 ml. mash. This is accomplished by introducing the desired amount of the thick mash into the fermenter, with gentle agitation or stirring of its contents. The quantity of thick mash introduced is determined by the amount required to produce the extra amount of alcohol desired; and care must be observed to insure that an increase of alcohol over 8.0 percent by volume is not provoked until the desired bacterial action has occured. When using the culture of *Clostridium saccharo butyricum* (Arroyo) which has been isolated and developed in the practice of this process, it has been found that the rate of alcoholic fermentation is greatly accelerated after its incorporation in the fermenter, due to symbiotic action and mitogenetic radiation effects from bacteria to yeast. The fermentation will usually come to an end in from 28 to 36 hours, counting from the time of yeast innoculation. The alcoholic yields based on the total sugars used have been found to vary between 44.0 and 46.0 percent, with corresponding fermentation efficiencies of 0 to 95 percent, based on Pasteur's equation for the alcoholic fermentation of sugars. When no extra sugars are added, the usual alcoholic concentrations in the beers run from 7.0 to 7.5 percent by volume; while if additional thick mash has been introduced, the alcoholic concentration may be raised to from 9.0 to 11.0 percent.

In preparing heavy rums, distillation of the beers or fermented mashes is best conducted in a discontinuous or batch still provided with an efficient rectifying column and total reflux condenser. Continuous stills may be used if specially designed for the purpose. However, preference is given to the discontinuous system of distillation. In distilling, the resulting beer from the fermenter may be distilled directly, or it may be allowed a certain period of rest, varying from 12 to 18 hours. The latter practice is preferred, as it greatly improves the quality of the resulting rum. In either case, the kettle of the batch still is charged, and its contents are carefully brought to gentle ebullition. This gentle boiling should be maintained during the whole distillation period, by careful control of the steam admitted to the coils of the kettle. At the beginning of the evaporation, the ascending alcoholic vapors are totally refluxed back to the column, for a time which is determined largely by the particular characteristics which it is desired to impart to the end product. It has been found that two to four hours of refluxing is appropriate in most cases. This refluxing increases the esterification leading to the production of high boiling point, high molecular weight esters which are so essential a part of a true heavy rum; besides, it causes the accumulation of low boiling point products at the top of the column, so that when the so-called head products are separated they will pass off with a minimum total volume of distillate. When the period of total refluxing is over, the distillation proper begins.

At the beginning of the selective distillation, the head products should be taken off for an amount which is determined experimentally for each individual case, and based on practice and experience. Generally speaking, and for orientation of the inexperienced in the practice, from 0.5 to 1.0 percent of the total volume of the beer should be separated as head products. After these head products are collected, distillation of the body, or main products, is continued, in a separate container. When the proof of the distillate falls to an apparent degree of about 130, the distillate is again led into the head products receiver until a new apparent proof of about 80 degrees is registered at the test gauge. At this point, the distillate is again led into the main products receiving tank until the end of the distillation period. The body of main products, composed of the second and fourth fractions, will average from 150 to 165 proof, depending on the original concentration of alcohol in the beer, the total time of refluxing before starting the distillation proper, and the rate of distillation during the operation. Those portions of distillate which have been collected in the head products receiver, being the first and third fractions, may amount to about 10 to 15 percent of the total alcoholic liquors distilled. They may be stored in special receivers until enough has been accumulated to permit a separate further distillation. When so collected, they are first diluted to an alcoholic concentration of about 20 percent by volume, and the foregoing distillation procedure is again effected thereon, with the exception that in this case the products separated from the body or main products, i.e., the first and third fractions, are totally discarded.

The described process of fermentation and distillation affords a fine product, due to the presence therein of valuable aromatic bodies, and the exclusion therefrom of deleterious aromatic bodies that heretofore have been eliminated by lengthy aging. This gives a minimum expense for maturing in the case of the rums produced by the process, and, in fact, the raw rums so manufactured have been found to reach full maturity in but a fraction of the time usually allotted for the aging of heavy bodied rums. In the foregoing description reference has been made to the employment of the symbiotically active co-ferment in the form of bacteria which assist in providing the extra desired and necessary flavor and aroma constituents. A number of bacteria and a mould of the "fungi imperfecti" group were found adequate and well suited for the purpose, particularly bacteria members of the propionic and butyric acid groups. The bacteria must conform to the following specifications: (a) Their life activities should not be arrested too soon by the metabolic products of the yeast formed during the fermentation period, particularly by the ethyl alcohol. (b) They must not attack or decompose, or materially change, the existing products of the yeast metabolism to such an extent as significantly to reduce the yield of alcohol. (c) They should possess the power to act upon the residual sugars of the alcoholic fermentation, utilizing these sugars in the elaboration of the products of their own metabolism. (d) Their metabolic products should be of such character as of themselves to enhance the flavor and aroma of the resulting rum; or of such nature that they will readily combine chemically with the metabolic products of the yeast (particularly with ethyl alcohol) to form highly flavored aromatic compounds. (e) They must be of such nature as will readily and fully act in the same class of substrate as is required for the alcoholic production when the fermentation is properly conducted.

Clostridium saccharo butyricum (Arroyo) produces a mixture of valuable aliphatic acids, consisting principally of normal butyric, acetic and propionic acids, but also including about one percent of other organic acids of higher molecular weights, such as caproic, heptoic and others. No appreciable amounts of alcohols, aldehydes, or ketones are found in the metabolic products of this particular culture. This organism possesses also the power of irradiating the so-called mitogenetic rays of Gurwitsch, which greatly activate the yeast culture when acting symbiotically therewith in molasses mashes under the aforesaid controlled conditions. The effect of this activation appears in an increase in the power of yeast multiplication, resulting in a more rapid fermentation and formation of alcohol than when the yeast acted alone in pure culture in similar mashes. This effect is revealed in the accelerated rate of fermentation following the addition of the bacterial culture to the fermenter. It is found that the bacteria became inhibited whenever the sugars concentration of the medium was higher than about 6.0 grams of total sugars per 100 ml. of mash, or whenever the alcoholic concentration in the fermenting liquid was over 8.0 percent by volume, or whenever the pH value of the medium decreased until it approached the value of 4.0. Therefore, the foregoing procedure includes the necessary steps for maintaining the pH well above 4.0 for withholding inoculation with the bacterial culture until the sugars in the fermenter reduced to below about 6.0 grams per 100 ml. of mash, and for using such sugars concentration in the mashing operation that not over about 8.0 percent of alcohol by volume is present in the beer during the course of bacterial fermentation.

amount of non-alcohol number was most significant difference between and light rums. Fractional distilla- in both types of rums, supplemented emical and organoleptic tests per- on the individual fractions in each have shown that the most striking ice consisted not so much in the size the individual composition of their ive non-alcohol numbers. For in- it was found that the individual nd aldehydes in the non-alcohol num- light rums consisted almost entirely pounds of low molecular weight and oiling point; while in the case of rums, the esters and aldehydes pres- sist to a very considerable proportion pounds of high molecular weight, oiling point, which pass over with h and sixth fractions during frac- listillation of the sample. It was also hat the fusel oil content was higher case of the light rums, when con- in proportion to their non-alcohol . The volatile and total acidities are igher in heavy than in light rums. In comparative analyses of a heavy rum a light rum, the following differences oted:

	Heavy Rum	Light Rum
of persistence of taste and aroma	1: 2,000,000	1: 5,000
l by volume	48.84	44.24
cidity (mg. per 100 ml. 200 proof alcohol)	294.91	24.27
acidity " " " " " " "	253.70	15.44
e acidity " " " " " " "	41.21	8.83
" " " " " " "	198.20	29.78
des " " " " " " "	55.70	25.90
alcohols " " " " " " "	82.94	90.41
" " " " " " "	1,390.10	518.00
Extract " " " " " " "	20.20	23.60
sters to higher alcohols	239:100	33:100
sters to volatile acidity	481:100	451:100
sters to aldehydes	356:100	154:100
f volatile acidity to total acidity	16:100	36:100
f high to low boiling point esters	80:100	37:100
f high to low boiling point aldehydes	98:100	97:100
on-alcohol number	631.75	180.36
f higher alcohols to non-alcohol number	13:100	50:100

ios above indicated can be employed nates of rum quality in that the is improved, for instance, in the heavy rums in proportion as the high-boiling-point esters and alde- o low-boiling-point esters and alde- pproaches unity. This ratio is much n the case of light rums. A high heavy rum should have this ratio surpassing 1:2, and for the better s of the present procedure this ratio hes and in some cases exceeds 1:1. eptic tests for aroma and taste have that the taste and aroma of the high ar weight, high boiling point esters ehydes are much superior to those of boiling point, low molecular weight nd aldehydes. The 'index of per- " is from 10 to 20 times higher in vy than in the light rums. These ons explain why good heavy rums with the main distillate, since these products are composed almost entirely of the esters and aldehydes of low molecular weight, low boiling point, and poor index of persistence. It also explains why the incorporation of a co-ferment such as *Clostridium saccharo butyricum* (Arroyo) or other proper organism to the fermentation under controlled biological and chemical conditions can result in great improvement of rum quality in aroma and flavor, since the acids produced by this bacterium form esters with the usual alcohols found in yeast fermentation, which are considered among the most valuable constituents of a genuine heavy rum, particularly the butyric, heptoic, and caproic acid esters.

The above conditions are preferred, but obviously are not rigid conditions for all operations. When other sugars and alcoholic concentrations in the mash are selected as more convenient or desirable, care should be taken to provide that the sugars concentration must be at or below 6.0 grams per 100 ml. of mash, and the alcoholic concentration in the fermenting mash not over 8.0 percent alcohol by volume for operation in the presence of *Clostridium saccharo butyricum* (Arroyo). In fact, the bacterial culture may be added during the finishing stages of the alcoholic fermentation if desired, since the bacterium is able to utilize the residual sugars of the normal alcoholic fermentation in the elaboration of its own metabolic products; and this is feasible provided that the alcoholic concentration by volume is then at or below 8.0 percent. When additional sugars in the form of thick mash are to be added during the finishing stages of fermentation it is customary to effect the bacterial innoculation as early as possible during the primary alcoholic fermentation, since by so doing the beneficial effects of the symbiotic fermentation have already taken place before the alcoholic concentration is increased due to the newly incorporated sugars, so much as to inhibit further bacterial action.

rum, as the molasses is thereby cleaned of foul-smelling substances, such as gases and other volatile compound usually in solution therein; and is also rid of organic and inorganic impurities which are always present in the molasses, such as excess ash and molasses gums. The successive separations, firstly upon the heat and alkaline treatment, and secondly upon the sulphuric acid treatment, lead to a far-reaching improvement of the raw material. The use of a supercentrifuge was found the most expeditious way of separating the impurities, but other means may be adopted, such as simple centrifuging in a specially built machine, filtration in a suitable filter, settling and decantation. The action of the heat during the pre-treatment renders the material practically free of microbiological contaminants, such as wild yeast, molds, and bacteria of various kinds which are always present in the raw material. The total sugars concentration in the molasses is also increased through the withdrawal of non-sugars; and the action of the heat, and later the action of the sulphuric acid, serve through inversion to increase the amount of readily fermentable monoses. There is also physical improvement of the raw material in that the viscosity is greatly reduced, and the material is much more easy to handle.

The addition of the milk of lime during the initial stage of the pre-treatment process has three main purposes: (a) It prepares the medium for the development during fermentation of the most important ingredient in the aroma of heavy rums, being the essential oil, or mixture of essential oils, to which the name of rum oil has been given. (b) It neutralizes the free fatty acids which are always present in molasses, thus eliminating the danger of their volatilization during the heating operation which immediately follows; but permitting the reliberation of these fatty acids from their calcium salts upon the sulphuric acid addition to the already cooled thick mash in the second stage of the pre-treatment. In this way these acids become available for the formation of valuable esters later during the fermentation period. (c) The disturbance produced in the medium through the alteration in pH values occasioned by the milk of lime causes a copious precipitation of organic bases, molasses gums, and mineral ash constituents of the molasses, and this precipitation is enhanced by the action of the heat applied. The nutrient requirements of the yeast and symbiotic bacteria are corrected at this stage when deficiencies are found upon analysis of the raw material. The aforesaid amounts of ammonium sulphate and calcium superphosphate are not restrictive or fixed, but are given as averages that have been found necessary when mashing Puerto Rican molases. For other cases, preliminary analysis of the raw ma-

terial and experimental observation will determine the amounts of the nutrients to use.

The unusually short period of fermentation is due to various reasons, such as the favorable changes in the substrate, resulting from the pre-treatment operation, the stimulating action of the bacteria upon the yeast on account of the mitogenetic irradiation, as the strict chemical and biological control exercised during mashing and fermentation. The temperature range for the fermentation previous to the incorporation of the bacterial culture may be maintained between 30° and 33° Centigrade, as this range will insure optimum conditions for the yeast strains used in this type of fermentation. At the time of innoculation with the bacterial culture, however, the temperature must be controlled within a range of 28° to 30° Centigrade in order to keep the bacterial culture from propagating too rapidly, as it would naturally do at a higher temperature with possible detriment to the yeast propagation and metabolic processes. It has been found in our experiments that when the propagation of the bacterial culture becomes such that the bacteria is present in large quantities and surpasses the concentration of yeast cells, then its activating action becomes detrimental to the yeast, as deleterious influences are noted in the yeast propagation and metabolism.

It has been noted as preferable to employ a batch or discontinuous still for distilling the rum. Comparative chemical, physical and organoleptic tests have indicated the preference, as it normally provides the advantages of a higher content of rum oil which is an aromatic compound of a high oily nature which passes over during the analytic fractionation of rums in the fifth and sixth fractions; and in the distillation of the rum begins to distill over when the proof of the distillate is about 80 (40 per cent ethyl alcohol by volume). It possesses the characteristic aroma of aged rums. A chemical study of this valuable rum ingredient indicates that it does not belong to the aldehyde, ester, or higher alcohol groups. Nor does it belong in the ketone class. Physically, it is a highly refractive colorless, oily substance, or mixture of such substances, of unknown chemical composition, but apparently belonging to the terpenes. Its boiling point is somewhat higher than that of ethyl alcohol, and it is more soluble in alcohol than in water. The index of persistence of its aroma was found to be extremely high. Additional advantages of the batch method are that a higher boil is obtained in the rum; a higher content of aromatic esters and aldehydes of the high molecular weight, high boiling point class obtained in the non-alcohol number of the rum; the rum has a better flavor and aroma the rum is higher in its index of persistence of aroma and flavor. Chemical studies of the distillation on the pilot plant batch s

giving constituents begin to pass over the proof of the distillate approaches d 80 degrees, and also the valuable oil begins to distill profusely at this of the distillation. Hence, it is pref- to provide for reception of this on of the distillate in the main body er. The separation of a great part head products and of the distillate on which passes over between 130 and oof is preferred, as this greatly im- the commercial product or main

ombined procedures have the advan- of a comparatively short time for the etion of the fermentation; unusually ields and fermenation efficiencies for ype of rum fermentation; economy of space and labor, with low capital in- nt; elimination of danger of fer- tion failures; maintenance of uni- y and high quality standards in the d product; ability of the product to ve quickly with age for this type of economy in shut-down periods for ng, as the purification of the raw ma- renders the necessity of securing in- nt, and effects savings in chemicals, and steam for the purpose.

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Milton S. Hershey

S. Hershey, chocolate manufacturer, thropist, and owner of Cuban sugar ties, died October 13 at Hershey, lvania, the town which he built. He 3 years old. Mr. Hershey began his ss career selling candy from a wagon ladelphia. He next entered the car- naking business and after two failures shed a business in Lancaster which fifteen years he sold in 1903 for ,000. With the money he bought acres near his birthplace and built manufacturing plant around which n of Hershey grew up. The Hershey ty now covers 12,000 acres, and the of 4,000 people has become an in- l show place, with golf course, swim- ool, a sports arena seating 8,000, a hotel and elaborate ballroom, and rshey Industrial School for Orphans Mr. Hershey endowed with a trust of $60,000,000 administered by a of directors. With the growth of ocolate manufacturing business Mr. y branched out into the sugar in- acquired plantations in Cuba and is own sugar mill and refinery, Cen- ershey, near Havana. The Cuban ties now comprise three mills, y, Rosario and San Antonio, with lantations, villages, and 267 miles necting railroad. Having no children own, Mr. and Mrs. Hershey became ed in the education of orphan boys, is became the major interest of Mr. in 1915. In 1937, after his eighty-seventh birthday, Mr. Hershey resigned all of his corporate offices except the chairmanship of the Hershey Chocolate Corporation. By his will his estate, valued at more than $80,000,000, is left to "the orphan boys of America." The direction of his business enterprises goes to P. A. Staples, president and general manager of the Hershey Corporation and business associate for more than a quarter of a century.

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New Cane Variety for Florida

Washington.—Sugar cane growers in the Florida Everglades will have a new variety to plant this fall, the United States Department of Agriculture announces. The new variety, C.P. 34/79, has been tried out in field tests over a number of years, and is now released for general planting. Growers in the Everglades, the only region where experimenters are sure it is well adapted, will be able to get stocks for planting from the United States sugar plant field station at Canal Point, Florida. The new variety compares well with the leading varieties now grown in Florida in sugar yield per ton and in tonnage of cane per acre on all the Everglades soil types. It is an early to mid-season cane, especially adapted to the peat (sawgrass muck) soil of the region, where it has surpassed all other varieties in yields of cane and sugar per acre. It also appears to be adapted to the sand and muck soils of the Fellsmere area. C.P. 34/79 has a spreading top which shades the row and "closes in" quickly, thus smothering weeds. The stalks are of medium the most adverse conditions. Seed cane of the variety germinates well, and gives a good stand. The cane has good stubbling (ratooning) qualities, the decrease in yield from plant cane to first stubble being very slight. It is resistant to red rot, leaf spot diseases, and mosaic. Results obtained in Louisiana show it to be resistant to the sugar cane stalk borer. Its disadvantages are a rather high fiber content, which makes its milling qualities about like those of the harder commercial canes, and susceptibility to chlorotic streak, which disease, however, is so far unknown in Florida.

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Sugar School at Idaho University

With the cooperation of the beet sugar industry, the University of Idaho has inaugurated a "sugar beet school" in its college of agriculture to train young men (and women) in the technology of this highly specialized industry. Plans for the school are outlined in a recent number of the college of agriculture's *News-Letter*. The school is announced as the first of its kind in the United States. The course of study will occupy four years, and will include practical work in beet sugar factories as part of the training. Officials of the Amalgamated and Utah-Idaho sugar companies were consulted before the plan was announced and expressed great interest, and the hope that the school would in time do for the western beet sugar industry what the Audubon sugar school in Louisiana has done for the cane sugar industry in the way of providing it with a supply of trained technicians.