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our government turned deaf ears to any such proposals. Now we read that the Department of Agriculture is recommending adoption of a plan for producing butadiene rubber from excess grain. A few years ago we were told that fermentation alcohol never could compete with gasoline in the United States. Now it appears that we can even make synthetic rubber from it on a competitive basis with oil. Had the government supported the alcohol program so strongly recommended by the advocates of farm chemurgy a few years ago, we should have had a long start on Europe in a synthetic rubber industry. All in all, it may be that our example to our neighbors of what not to do with their agricultural surpluses will prove of more value to them than all the money we have loaned them to perpetuate excess sugar production. If they will be dissuaded from doing most of the things that we have done, our mistakes will have been invaluable. Present wars are not won by past strategies, and we shall learn sooner or later that current depressions are not cured by the blue prints of previous ones, nor by formulae that once proved efficacious. The most that the sugar industry can do now to prepare for the return of peace and its accompanying problems may be too little, but it must certainly not be too late if it is to be effective.

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The Manufacture of Rum

Part V

Curing and Maturing the Product . . Dilution of the Distillate, Removal of Odor, Aging Methods

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

IT IS not only the length of time that a rum is kept aging in an oak barrel that imparts to it the characteristics of matureness, for there are rums that in a comparatively short time will acquire all the requirements of mellowness, taste, body and aroma pertaining to a cured product; while others will require from two to three times longer to come to the same degree of matureness. Hence, the factor of quality of the raw distillate plays the most important role in natural aging, and for that matter, artificial aging as well. The sooner this fact is accepted by rum producers, the sooner will really good rums be on the market. Unfortunately, the trend seems to be to the belief that quality of raw distillate is of immaterial consequence if efficient curing methods are available. This is a grave, fundamental error. The rum that is poor in quality at its birth—that is, as a raw product—will never become a first class product, no matter what treatments and retreatments it may be made to pass through. It will be benefited in some cases, and improved; but never will it become a rum of real value.

The quality of the oak barrel is a very variable factor, and one over which the average rum manufacturer has little or no control. This quality of the barrel will depend on a great number of conditions incident to its manufacture. For instance, character of the soil and climate of the region where the trees were grown; age of these trees when cut; manner in which they were cut; the part of the tree from which the boards of the barrel were made; variety and content of resins and extractive matters of various classes existing in these boards, and last, but not least, the period of aging given the boards before the barrel was constructed. Irrespective of the quality of the oak barrels on arrival at the distillery, they are not in condition to be utilized at once for rum curing. Before using them at all, they must pass through a preliminary treatment, and the nature and extent of this treatment will depend on the original quality of the barrels. With the best grade of plain oak barrels, they must be subjected to the following or analogous process: the empty barrels are steamed inside or submitted to the action of boiling water until the condensed steam or hot water leaving them shows no trace of color or taste of any kind. Then they are filled with a weak hot solution of sodium carbonate (about 0.5% solution) for two or three days. After that, they are filled with cold pure water, which is changed every 24 hours for a week or so. Lastly, the barrels are filled with a weak solution of alcohol in water (about 20% by volume) to which has been added about 0.5% by volume of ordinary 28% acetic acid. This solution is left in the barrels until they are to be filled with raw rum. We have seen many a first class raw distillate ruined by storing in an unprepared barrel.

The size of barrel to be used for rum curing is no light matter. The

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distiller should consider this point well before making a decision. Small barrels (15 to 25 gals.) will greatly accelerate the curing of the rum, while large barrels (over 50 gals.) will retard it. This is due to the effect of surface volume ratio and also to the fact that large barrels must be constructed out of thicker boards, which present greater obstacles to the free entrance of air and to the exit of water and alcohol molecules. But, on the other hand, the use of small barrels calls for extra labor, expense, space, and larger losses of alcoholic strength and total volume of contained liquid. Therefore, a compromise must be reached by which comparatively quick maturing may be secured without undue extra expense. The writer recommends the 15 to 25 gallon keg for small distillers and the 35 to 50 gallon barrel for the large producer. However, if the distiller is in no hurry about aging time, it will not matter if he uses barrels of 150 gallons or more capacity; especially if his raw distillate is of exceptionally good quality. Recently the rum industry has been copying from the whiskey industry in the introduction of charred barrels for rum curing. These barrels possess the advantage of accelerating the curing process and of imparting natural coloring to the distillate at a much faster rate than plain barrels. But they also impart a very pronounced "woody" taste to the aging liquor, which in the case of whiskey is unimportant, and even desirable, but which is very objectionable in the better grades of rum. If it is desired, then, to use charred barrels for the sake of shortening the curing period, our advice is to use them only temporarily; that is, during the first quarter of the total aging period, and then transfer the liquor to well prepared plain barrels of the highest quality.

As to the length of the aging period, we have just discussed how it is affected by the quality, class and size of container; and we also previously stated that this aging period is affected to a still greater extent by the original characteristics of the raw distillate. As a general rule, the period for rum curing is but a fraction of that required for the curing of whiskey. Aging for a longer period than four to five years is practically useless, as there will be practically no improvement after this time. Well fermented and better distilled rums will reach full matureness in a period of one year and even less. They will be in condition for the market in less than one year, if desired, when a moderate price is sought for them. The writer has had samples of his experimental rums varying in age from 6 to 15 months, that were declared by world famous rum testers to represent "a very fine liquor of many years aging in oak barrels"; while every one of the rums so far made by him have been in drinking condition after an aging period not exceeding six months.

Temperature and relative humidity of the storage place will also influence the aging liquor. High temperatures (between 40-45°C.) will greatly hasten the curing process, but great care must be taken with the losses through evaporation. The average temperature should be around 35°C. for fairly rapid curing. Relative humidity affects the course of curing in the following way: when the relative humidity is quite high, the aging liquid will lose more alcohol than water by evaporation through the pores of the barrel, and when the relative humidity is low the stored liquid will lose more water than alcohol. Hence, since raw distillates are cured through loss of alcohol, relative humidity should be high during the first stages of the aging period. Then, as the liquor commences to show signs of matureness, the relative humidity should be lowered gradually, the lowest possible ratio being maintained during the last stages of the curing process.

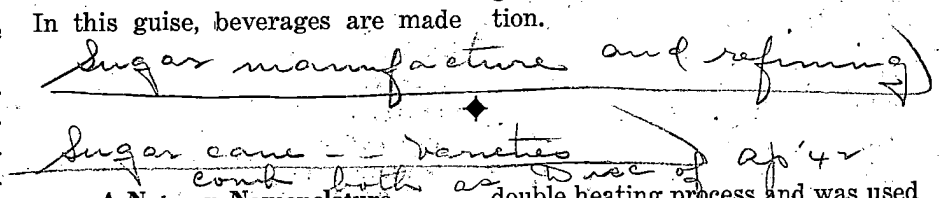
The different factors affecting natural curing having been discussed, although in a superficial manner, the question still arises: how, in what manner, is the curing effected in the barrel? There exists no perfect elucidation of the phenomena of rum curing, and undoubtedly there is much to learn and investigate about this fascinating subject; but according to what little we know, the process may be attributed to the following factors: (1) The slow evaporation of a portion of the alcoholic content through the pores of the barrel, aided by the conditions of temperature and relative humidity prevalent in the place of storage. (2) Dissolving action of the alcoholic solution on some of the constituents of the boards of the barrel. (3) A series of chemical combinations, condensations, and oxidations developed through catalytic action of some of the mineral constituents of the barrel; through the oxidizing action of the oxygen of the air; and through interreactions among the original constituents present in the raw distillate, and those extracted from the barrel by the solvent action of the stored liquid. (4) To the temperature and relative humidity prevalent in the curing place at different stages of the aging process. This has been already considered elsewhere. (5) To the state of equilibrium finally reached after the different above-described reactions have been satisfied, and a balance has been reached between substances originally in the raw distillate, newly formed ones, and those extracted from the wood of the barrel.

We shall finish this chapter on rum manufacture by touching lightly on the matter of accelerated curing of the raw distillate. Not all, or rather very few, of the rums in the market (we refer to the American market, and not the European) have passed through the curing process outlined above. Our era of acceleration and impatience in all the affairs of human endeavor would not allow of an exemption in the case of rum manufacture. On the other hand, the ever increasing demands of the trade, the lack of adequate working capital, the anxiety for immediate

returns, immoderate and unfair competition, and many other influences of the business, compel the manufacturers to place their products on the market in the shortest possible time. As a direct result of the above mentioned conditions, accelerated or quick aging processes have been developed, and are being developed all the time. There exist practically as many methods as rectifiers. Judging from what has been accomplished thus far, and from the nature and quality of the "rums" thus produced, the writer's opinion is that the results obtained are very relative, insufficient, and mediocre; leaving the problem of artificial or accelerated rum curing an open question. Far from our mind, however, is the idea or insinuation that some quick curing process, capable of competing with the slow method, may not be evolved. Moreover, the advent of such a process would so revolutionize the industry as to become an epoch-making event in rum manufacture.

Processes for rapid curing may be divided into two general classes: (1) Those merely tending to accelerate the reactions and changes occurring in natural aging thus accomplishing matureness of the product in a shorter time; but without the addition to the raw material of extraneous ingredients, so-called bearers or carriers of rum taste, body and aroma. (2) Those intended to accomplish the results mentioned under (1), but using in addition these extraneous matters, or so-called carriers of taste, aroma and body. The methods used under (1) will fall into four main divisions: (a) moderate heat treatment or intense cold treatment, or alternate treatments of heat and cold; (b) treatment with compressed air, oxygen, hydrogen peroxide or ozone; (c) exposure to actinic rays; (d) electrolytic treatment and use of catalysis. Discussion of these several divisions of treatment No. 1 will not be necessary here, as the American industry is well acquainted with them through their similar application in whiskey and brandy curing by quick methods. Methods used under (2) above, may include all of the methods under (1), besides the addition of flavoring and aromatic substances for development of taste and bouquet. Among these added substances we have: (1) sugars, of various kinds, sucrose, dextrose, cane syrup, bee honey, etc.; (2) infusions of herbs, leaves, barks, roots, etc.; (3) fruit alcoholic extracts, among which prunes, peaches, apricots, figs and oranges are in use; (4) addition of esters of commerce, especially the cheap ethyl acetate, and more rarely the propionate and butyrate; (5) various essential oils are also employed, among which we may mention oil of cloves, oil of cinnamon, orange oil, and bergamota; also natural or artificial vanilla flavor, cassia flavor, benzaldehyde, etc. Recently, the custom has been introduced of using various sweet wines such as the various kinds of "Malagas" and "Moscatels" of Spanish origin.

In this guise, beverages are made that although more deserving of the name of cordials or liqueurs, are labelled with the name of rum. We frankly believe that all of this is avoidable and unjustified, should more and better attention be bestowed on the different stages of rum manufacture, and especially rum yeast selection. A clearer realization of the fundamental differences existing (or that should exist) in the methods of industrial alcohol and rum manufacture would improve matters a great deal. The idea of producing industrial alcohol first, and then trying to artificially convert it into high quality rum is absolutely erroneous and has given rise to the innumerable poor representatives of true rum now on the American market. Most of these brands would be utterly unsalable in Europe, where the true and genuine taste of rum is easily distinguished by the consuming public. Governmental regulations and inspection of the rums imported would be a great help towards securing the genuine article for public consumption.



A Note on Nomenclature

A letter from J. G. Davies, sugar technologist with the Imperial College of Tropical Agriculture in Trinidad, raises a point of nomenclature in connection with the article "Notes on Cane Juice Treatment" published in the April issue of Sugar. Mr. Davies writes: "I have read with interest the able article by Earl L. Symes in the April 1942 issue of your journal. But as a research worker and the originator of some of the work to which the author refers, I would wish to record the following comments: "At the top of column 3, page 26, after a discussion on superheating, it reads 'It is quite probable that a small amount of lime was added to raise the pH to 6.3 before heating, and that after superheating the liming was continued to 7.0 pH or higher. This became known as the fractional liming and double heating process and was used in many countries to deal with refractory juices.' The process which Mr. Symes thus describes is that known in the British West Indies as 'preliming' and it cannot be correctly described as fractional liming and double heating because there is no second heating. The term 'fractional liming and double heating' was, as far as we know, first used by my co-workers and myself. The process was certainly first described in print in our article in *I. S. J.* (1936, *38*, 298), at which time it was a new process. Unfortunately, the position is further confused by the fact that Mr. Symes, in dealing with that particular reference, called our process 'double liming and double heating' instead of using the name we use and which has become well known to the industry."