

Documents to U / MNU Lending

University of Minnesota – Interlibrary Loan Lending

OCLC MNU & UMM * DOCLINE MNUMIN

**15 Andersen Library, 222 21st Ave. S., University of Minnesota
Minneapolis, MN 55455-0439 USA**

Phone: 612-624-4388, Fax: 612-624-4508, e-mail: docstou@umn.edu

*This article is delivered directly from the collections of the University of Minnesota.
Thank you for using our service.*

If you have problems with delivery, please contact us within 48 hours.

Notice: This material may be protected by copyright law. (Title 17 U.S. Code)

DTUMNU

GLJ 2/25/16

DTUMNU

LENDER

BORROWER

Return to:

MNU

Ship to

BRL



Transaction # 1110841
In Process Date 2/24/2016

164608433

Title: Annales de technologie agricole The Rum Pilot Plant of the agricultural experiment station of the university of Puerto rico

Author: A.E. Molini

Article Title: The Rum Pilot Plant of the agricultural experiment station of the university of Puerto rico

Article Author: A.E. Molini

Holdings: Vol: 24 No: 3-4 Date: 1975 Pages 391-396

ISSN: 00034223

Imprint: [Paris] Institut national de la recherche agronomi 1975

Copyright: CCL

TMAGR
Periodicals

available

of Pieces 1
Request Note
Billing Default
Max Cost 16.00IFM

Ship To. INTERLIBRARY LOAN
BOSTON PUBLIC LIBRARY
700 BOYLSTON ST
BOSTON, Massachusetts 02116
United States

MNU E-DELIVERY

R L'USO INTEGRALE
ERIE DI RUM,
A DEL RUM
AGRICOLA
RICO

è stato elaborato nel 1972 un vasto
impiegate per l'alimentazione del
to forma di solfato complesso di
ire a migliorare il valore nutritivo
Altre prove sono effettuate per la
i di biomassa o per l'idrolisi della

THE RUM PILOT PLANT OF THE AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF PUERTO RICO : PAST, PRESENT, FUTURE

A. E. MOLINI ⁽¹⁾

*Rum Pilot Plant,
Rio Piedras,
Puerto Rico 00928*

SUMMARY

The rum pilot plant was created in 1953 in order to support the rum industry in Porto-Rico and to maintain the quality of its products at a high level. Yeasts strains able to ferment up to 14° of alcohol have been selected. The antiseptics and antibiotics have been used to secure pure fermentations. The high-proof distillation proved to be suitable for the production of high quality light-bodied rum. The irreplaceable role of wood in aging has been stated. Modern methods have been suggested for rum analysis.

The economic importance of the rum industry for the Commonwealth of Puerto Rico is a well established fact. Rum revenue, which in the 1973-1974 fiscal year alone amounted to \$ 120 millions, continues to make its outstanding contribution to the well being of the Puerto Rican people through the industrialization program of the Commonwealth government and the betterment of educational, cultural, agricultural, health, and transportation facilities throughout the island. Total revenues collected by the island treasury exceeded the \$ 1.0 billion mark during early 1974. There is still much work to be done and, if higher and better standards of living in Puerto Rico are to become a reality, the rum industry must continue doing its share. The

⁽¹⁾ Dr. A. E. Molini wishes to acknowledge the work of the following personnel of the Rum Pilot Plant : Aguiar, Juan. L. ; Aguilera Flores, Cruz ; Alfonso Ribera, Héctor ; Batiz Hernández, Heriberto ; Belardo Yadós, Amador ; Brau, Herminio M. ; Calderón Tomei, Benjamín ; Camacho, Belén M. ; De Ayala Gallsá, Zulma ; Fernández de Murphy, Nivia ; García Porrata, Asdrúbal ; García Morin, Manuel ; García Ortiz, Héctor ; Lindegren, Carl C. ; Medina, María ; Montalvo, Milagros ; Morell de González, Isabel ; Rodríguez Benítez, Víctor ; Rosado González, Eduardo ; Saavedra Zamot, Diego ; Sánchez de Torres, Calixta and Soltero, Elena.

product has to compete in the United States and world markets with other alcoholic beverages of high quality and preferences. For these reasons, it is absolutely necessary to keep improving the quality of the Puerto Rican rums. To do so, Puerto Rico must continue building up a sound reputation for its rums based on quality as indicated by excellence standards. It is thus pertinent for the rum industry to have at its disposal the most accurate and precise techniques possible to control and improve the quality of the product.

The demand for Puerto Rican rums in the continental markets increased rapidly during the second world war. Unexpected sales levels were reached because of the virtual absence of whiskey from the market. Hence, the reserves available at the warehouses of the rum manufacturers were exhausted in a short time. Properly aged rum was no longer available and rum with little or no aging appeared in the market. These sales seriously harmed the prestige of Puerto Rican rums. After the war, when whiskey, as well as other beverages became available, the sales of Puerto Rican rum in the continental market dropped markedly reaching levels even lower than those prevailing before the war. The Puerto Rican Government promptly recognized that to recover and maintain a reasonable portion of the continental market for strong alcoholic beverages, it was necessary to offer a product of high quality. Research work at the Agricultural Experiment Station dating since 1938 and done by ARROYO indicated the route to achieve good rum quality. A research effort was initiated in 1945 to ascertain the leads developed by ARROYO. These were corroborated by 1947. Because of these reasons, the Rum Pilot Plant of the Agricultural Experiment Station of the University of Puerto Rico was specially created by an act of the legislature of Puerto Rico, and was officially opened on march 18, 1953 with the specific objective of developing and providing the technical expertise required to place and maintain the industry and the quality of its product in a healthy position. The establishment of the Rum Pilot Plant opened a new era on the manufacture of rum.

WHAT IS THE RUM PILOT PLANT ?

The rum pilot plant is an experimental rum distillery provided with the most modern equipment and facilities of the day for the production of fermentation alcohol and rum. The fermentation and distillation units are flexible, so that experiments in the various fermentative and distillation processes known can be readily conducted. The laboratories are well equipped with all the instrumentation required for the application of the most modern techniques to studies on rum and alcohol.

Scientific investigations are conducted in all the phases comprising the manufacture of rum and alcohols by the fermentation of sugarcane molasses. The knowledge obtained in these studies is promptly transmitted to the rum industry of Puerto Rico. The industry has always been free to utilize to their best advantage the information developed at the Rum Pilot Plant. The Rum Pilot Plant does not have any regulatory function over the industry.

Government agencies utilize the services of the Rum Pilot Plant on matters related to the rum and alcohol industry.

ACHIEVE

The following achieve

The importance of cultures was demonstrated in as 14 p. 100 by volume at f A collection of yeast cultu throughout the world, is induced mutations and ar Plant is available to the 1

The conventional bar optimum operating condit continuous fermentation p micals was demonstrated organisms. Data was obt tation. The results indica early states of the former

Studies were conduc industry. Procedures were of distillation columns to possible selection of the c other than the inability to nience of distilling at the Proper selection of the le ration of congeneric subs fusel oil and unidentified also demonstrated that ex of light bodied rums. Furt for the existence of legal duced at an alcoholic co classified as an alcoholic l congeners in order to be

An instrumentation s lation which by itself per reliable way to get good

ACHIEVEMENTS OF THE RUM PILOT PLANT

The following achievements of the Rum Pilot Plant can be mentioned :

1. — *Yeast strains*

The importance of conducting the alcoholic fermentation with pure yeast cultures was demonstrated in semi-commercial scales. Alcohol concentrations as high as 14 p. 100 by volume at fermentation efficiencies higher than 90 p. 100 were achieved. A collection of yeast cultures was developed from strains obtained from institutions throughout the world, isolation from wild sources and from strains developed by induced mutations and artificial hybridization. The yeast collection of the Rum Pilot Plant is available to the rum industry of Puerto Rico.

2. — *Fermentation processes*

The conventional batch fermentation process was defined by establishing the optimum operating conditions of the several process variables. The incremental and continuous fermentation processes were investigated. The use of antibiotics and chemicals was demonstrated for inhibiting contaminant bacteria and other microorganisms. Data was obtained on the formation of congeners during the fermentation. The results indicated that most of the congeners were produced during the early states of the fermentation process.

3. — *Distillation*

Studies were conducted on the various distillation processes of the alcoholic industry. Procedures were established for the start up and the continuous operation of distillation columns to produce high quality distillates, permitting the highest possible selection of the congeners. There is no justification for fusel oil in distillates other than the inability to perform the distillation in an efficient manner. The convenience of distilling at the highest possible proof was demonstrated for light rums. Proper selection of the levels of operational variables permitted the selective separation of congeneric substances to desirable extents, while reducing the content of fusel oil and unidentified tail substances in the main product to a minimum. It was also demonstrated that excessive concentrations of fusel oil destroys the good quality of light bodied rums. Furthermore, it was demonstrated that there is no justification for the existence of legal provisions which establish that the distillate shall be produced at an alcoholic concentration below a certain specified limit, in order to be classified as an alcoholic beverage and that neither must it have a minimum level of congeners in order to be classified as rum.

4. — *Automatic controls*

An instrumentation system was developed for the automatic control of the distillation which by itself permitted the operation of the distillation columns in the most reliable way to get good quality distillates consistently.

5. — *Aging*

Studies were conducted on the changes that occur in rums during the course of the natural aging process in barrels. The effects of various types of oak barrels on the aging of rums were studied, as well as the effect of adding different substances to the rums in the barrels at the beginning of the aging processes, such as activated carbon, oak chips, wood extracts, etc. The results conclusively demonstrated that none of these process artifacts by themselves can supplant natural aging in oak barrels to obtain rum of the highest quality.

Attempts to accelerate the natural aging of rum in oak barrels by conducting it at temperatures higher than ambient were effected. However, serious economic considerations and the inherent potential explosive nature of the atmosphere inside the warehouses have curtailed our effort in this area.

6. — *Processing*

The finishing operations of rum before bottling were defined by establishing the effect of such substances as activated carbons, filtering aids, coloring and flavoring agents, etc.

7. — *Analytical methods*

Detailed studies were conducted to select and develop a set of standard analytical methods to be used by the alcohol industry. We can assert that the methods of the Rum Pilot Plant are more sensitive and precise than the conventional methods available in the technical literature.

8. — *Organoleptic tests*

By the proper selection of a tasting panel, we are finally beginning to corroborate the results of organoleptic tests with chemical analyses.

9. — *Quality standards*

The Puerto Rico rum industry was provided with a set of quality standards which serve as a reference line for excellent rum quality.

10. — *Services to the industry*

Manufacturers of Puerto Rican rums have utilized free of charge the services offered by the Rum Pilot Plant such as : design and selection of equipment, development of special processes, definition of operating conditions, selection of control systems, training of skilled operators and technical personnel, analysis of samples, evaluation of the quality of the finished product, and general advice on all matters, including economic considerations. One very important service is to purify and revitalize yeast strains from the private yeast collection of the rum manufacturers.

Without any doubt, the accomplishments of the Rum Pilot Plant have had a marked effect on the economic and social well being of Puerto Rico and its rum

industry. At present, the conditions a year with levels high future. To keep abreast of the initiatives of the rum pilot plant. From an art to a scientific expect to lead it in all phases concentrate our efforts in su

1. Definition of the fact this purpose, we have initiate mills in Puerto Rico and fro

2. « Finger printing » the tify the more than eighty con to perform these analysis ro

3. Utilization of the ru benefit of Puerto Rico and t

4. Utilization of the fe: into such areas as the deve: protein and the developmen animal feeds.

We definitely envision available at the Rum Pilot I

L'USINE
DE LA STATION EXPÉRIMENTALE

Atelier-pilote pour le rhum
Puerto-Rico : Passé, Présent, Futur
L'atelier expérimental a été
pour maintenir à un haut niveau
tionnées pour fermenter jusqu'à
pour maintenir des fermentation
produire du rhum léger de bon
a été reconnu. Des méthodes m

EL
EN LA ESTACIÓN DE

El taller experimental ha s
del ron de Puerto Rico, así cor
Han sido seleccionadas estirpes

Annales de Technologie agric

t occur in rums during the course of various types of oak barrels effect of adding different substances aging processes such as activated its conclusively demonstrated that can supplant natural aging in oak

rum in oak barrels by conducting fected. However, serious economic ve nature of the atmosphere inside area.

g
tling were defined by establishing is, filtering aids, coloring and flavo-

ethods
develop a set of standard analytical can assert that the methods of the han the conventional methods avai-

tests
are finally beginning to corroborate analyses.

ardards
led with a set of quality standards n quality.

industry
utilized free of charge the services and selection of equipment, develop- ing conditions, selection of control nical personnel, analysis of samples, t, and general advice on all matters, portant service is to purify and revi- ction of the rum manufacturers.

of the Rum Pilot Plant have had a being of Puerto Rico and its rum

industry. At present, the contribution to the treasury amounts to more than \$ 130 mil- lions a year with levels higher than \$ 150 millions a year predicted for the near future. To keep abreast of the industry, it is logical to re-structure the efforts and objec- tives of the rum pilot plant. The rum industry of Puerto Rico has made the transition from an art to a scientific and technical endeavour. The Rum Pilot Plant cannot expect to lead it in all phases of the process thus we have chosen for the near term, to concentrate our efforts in such areas as :

1. Definition of the factors that determine the fermentability of molasses. For this purpose, we have initiated a program to characterize the molasses from all sugar mills in Puerto Rico and from some foreign countries.

2. « Finger printing » the minor constituents of rum. We aim to be able to iden- tify the more than eighty components detectable by chromatographic techniques and to perform these analysis routinely.

3. Utilization of the rum distillery wastes in an economic manner for the benefit of Puerto Rico and the rum industry.

4. Utilization of the fermentation expertise gained during the past 20 years into such areas as the development of low cost sources of biomass or single cell protein and the development of easily fermentable or digestible carbohydrates for animal feeds.

We definitely envision the utilization of the facilities, resources and expertise available at the Rum Pilot Plant for the further betterment of Puerto Rico.

RÉSUMÉ

L'USINE-PILOTE DE FABRICATION DU RHUM
DE LA STATION EXPÉRIMENTALE AGRICOLE DE L'UNIVERSITÉ DE PORTO-RICO ;
PASSÉ, PRÉSENT ET AVENIR.

Atelier-pilote pour le rhum de la Station d'Expérimentation Agricole de l'Université de Puerto-Rico : Passé, Présent, Futur.

L'atelier expérimental a été créé en 1953 pour soutenir l'industrie du rhum à Puerto-Rico et pour maintenir à un haut niveau la qualité de ses produits. Des souches de levures ont été sélectionnées pour fermenter jusqu'à 14° d'alcool. Les antiseptiques et les antibiotiques ont été utilisés pour maintenir des fermentations pures. La distillation à haut degré est apparue convenable pour produire du rhum léger de bonne qualité. Le rôle irremplaçable du bois dans le vieillissement a été reconnu. Des méthodes modernes pour l'analyse des rhums ont été proposées.

RESUMEN

EL TALLER PILOTO PARA EL RON,
EN LA ESTACIÓN DE EXPERIMENTACIÓN AGRÍCOLA DE PUERTO RICO :
PASADO, PRESENTE Y FUTURO

El taller experimental ha sido fundado en 1953, con objeto de servir de apoyo a la industria del ron de Puerto Rico, así como para mantener un elevado nivel de calidad de sus productos. Han sido seleccionadas estirpes de levaduras para fermentar hasta 14° de alcohol. Los antisépticos

y antibióticos han sido utilizados para mantener las fermentaciones puras. La destilación de grado elevado ha parecido constituir un procedimiento conveniente para producir ron ligero de calidad correcta. El papel insustituible de la madera en el añejamiento ha sido reconocido. Han sido propuestos métodos modernos para el análisis de los rones.

RIASSUNTO

IL LABORATORIO PILOTA DEL RUM
DELLA STAZIONE SPERIMENTALE AGRICOLA DELL'UNIVERSITÀ DI PORTO-RICO :
PASSATO, PRESENTE, FUTURO

Il laboratorio sperimentale è stato creato nel 1953 per aiutare l'industria del rum a Porto-Rico e per mantenere a un livello elevato la qualità dei suoi prodotti. Delle specie di lieviti sono state selezionate e lasciate fermentare fino a 14° di alcool. Gli antisettici e gli antibiotici sono stati impiegati per mantenere delle fermentazioni pure. La distillazione ad alto grado è apparsa conveniente per produrre del rum leggero di buona qualità. E' stato riconosciuta che il legno ha un ruolo insostituibile per l'invecchiamento e sono stati proposti infine nuovi metodi moderni per l'analisi dei rums.

POS
OF BUTYRI

Two methods of pro
studied.

Butyric acid bacteria
pombe in molasses medium
Addition of 15-30 p.
was effective for increasin
just a little.

Distillation of fermer
was available. Acid conte
of non-adjusted, higher p
is 135, while from adjust

By lowering pH of r
combine to form ester.

From analytical resu
sary to confirm by tastin

The production
derable amount. In tl
rial, but now, import
Table 1, shows alcoho
in Japan. Sugar cane
thern part of the co
molasses. Furthermo