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KINETIC STUDY OF FERMENTATION OF FERMENTABLE SUGARS PRESENT IN DATES VARIETY GHARS OF EL OUED REGION

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ABSTRACT

Dates variety Ghars from the region of El Oued in the south east of Algiers these dates rich in fermentable sugars are used for the production of bioethanol by fermentation. In this study we prepared bioethanol by fermentation of date must at the laboratoryl, to understand the kinetics of this transformation we followed the evolution of the must density, the sugar content, the pH and the absorption light at 490nm during fermentation.

Keywords: fermentable sugars, Ghars dates, El Oued, Biethanol

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1- INTRODUCTION

Ethanol or ethyl alcohol, strategic energy substance and base of many industries. Dates of low quality and crop date waste rich in fermentable sugars can be used as the best substrate for bioethanol production [1]. In our president study we have shown that 1kg of dates can produce up to 350ml of ethanol depending on the variety of dates used [2]. The purpose of this present study is to follow the fermentation process of dates to transform them into bioethanol and to discover the kinetics of this transformation. For this purpose we have used dates variety Ghars as a substrate for ethanol production, dates variety Ghars are very rich in

sugar the total sugar rate is between 60 and 80% [3,4] and we follow the evolution of the alcoholic fermentation parameters of the must (pH, density, sugar content and UV-Visible absorption) during the fermentation.

2. METHODS AND TECHNIQUES

2.1. Products and materials used:

• Dates (Ghars)

•Distilled water.

• Yeasts

• mixer

• Filtration device

• Bioreactor

• Distillation device

• Analytical balance

•pH meter

• refractometer

• UV spectrophotometer

2.2. Steps for producing ethanol by fermentation of dates

The production of ethanol from dates at the laboratory is done according to the following steps (diagram fig.1): cleaning and stoning of dates, preparation of date must, fermentation, distillation and rectification.

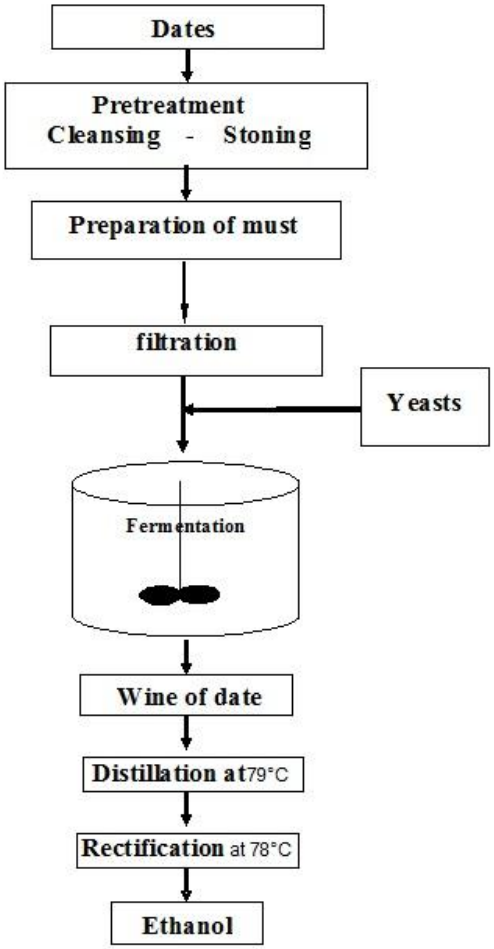

Fig.1. Protocol producing bioethanol from dates

The must of dates is a sweet liquid obtained by maceration of pitted dates (Fig.2) in hot water of 70 to 80 ° C. The quantity is determined by 1Kg of pitted dates for each 3L distilled water with continuous agitation stirring for 5 hours to avoid sedimentation of dates and maintain homogeneity at all mixing points.

Fig.2 Dates Ghars variety and the must of dates

After maceration, the mixture will be filtered to separate the fibers and the suspended materials and to obtain a filtered must. The product of the maceration of the dates and the mounting of the filtration are shown in the figure3.

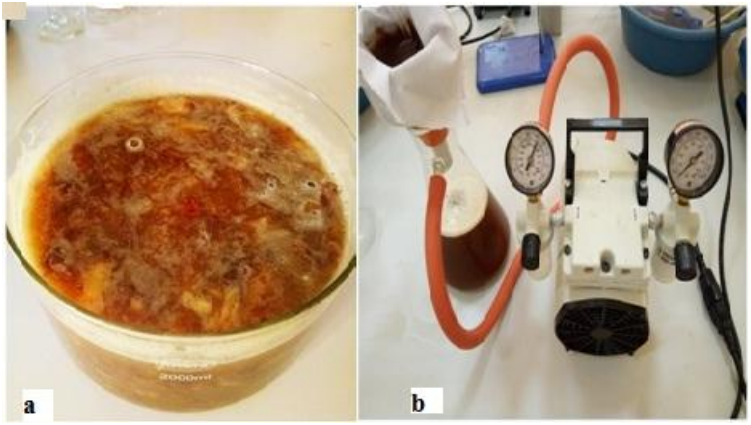

Fig.3. Filtration a) Product maceration b) Filtration device

2.3. Process of alcoholic fermentation:

The prepared must is used directly for anaerobic fermentation with the baker's yeast (*Saccharomyce servisie*), after it is developed in a medium enriched with mineral salts (ammonium sulphate, ammonium phosphate). The fermenter is immersed in a water bath, the amount of yeast used is 1g for 1 liter of must. Samples will be taken after 0, 4, 6, 8, 16 and 72 hours of the fermentation and the parameters are determined:

Density (mass / volume)

pH directly using a pH meter

Sugar content using refractometer NOVEX-HOLLAND Model 98.490

Absorption is determined by UV-Vis Spectrophotometer model Spectrum SP-UV 500DB

Distillation and rectification:

At the end of the fermentation, a wine of dates is obtained which must be filtered. To extract the ethanol, the filtered wine is distilled at a temperature of the order of 79 ° C, the Fig. 4a shows the distillation device used. The rectification of the crude alcohol requires a second distillation at 78°C. the alcohol content of the bioethanol obtained will be determined using an alcoholmeter (Fig.4 b).

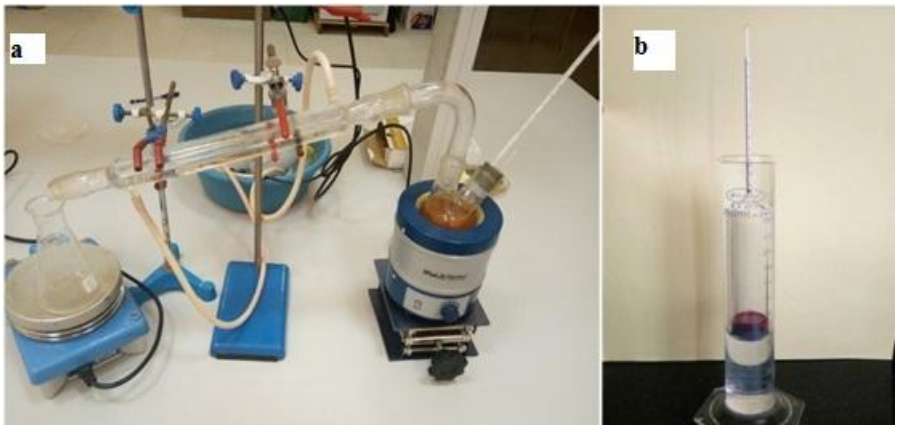

Fig.4 a) Distillation device b) Alcoholometer

3. RESULTS AND DISCUSSIONS

The results obtained from the analysis of the must during the fermentation: the density, the pH, the Sugar rate, the absorption and the volume of biethanol obtained for 200 ml of the must are grouped in Table 1.

Table 1. Physico-chemical analysis results

Time (h)	0	4	6	8	16	72
ρ (kg/l)	4.56	1.275	0.99	0.968	0.956	0.953
Ethanol (ml) (for 200 ml of must)	0	0	0.3	0.8	1.5	2.7
pH	5.62	4.86	4.67	4.5	4.24	4.30
Sugar rate (°Brix)	23	18	17.5	17	13.5	8
Absorption at 490nm	1.221	2.956	3.088	2.554	3.012	2.379
Alcoholic degree	60°					

3.1. The density

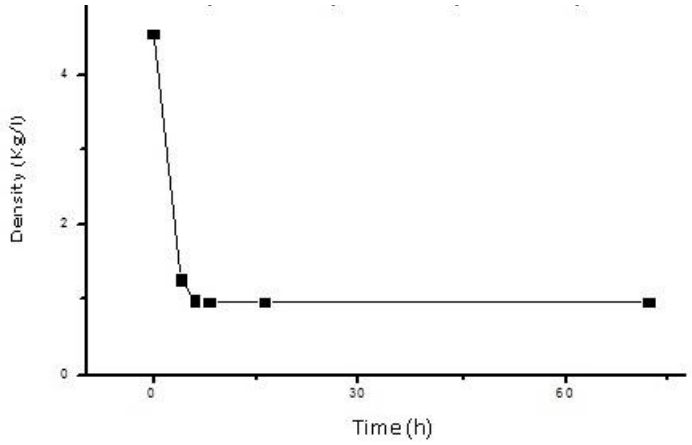

Fig.5. The density of the must a function of the fermentation time

Figure 5 shows a remarkable decrease in density during fermentation, which can be explained by the conversion of glucose to alcohol and loss of mass in the form of CO_2.

3.2. pH

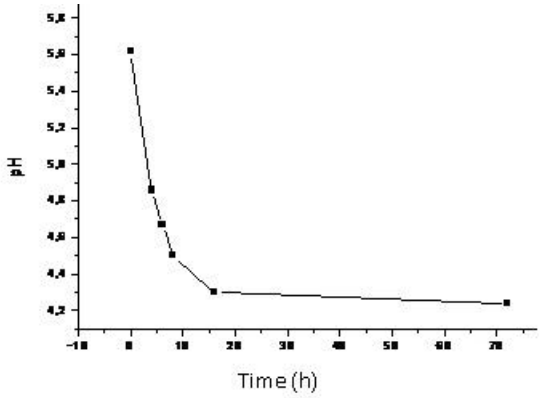

Fig.6. pH evolution

A rapid drop in pH (5.62 to 4.24) during the first twelve hours of fermentation (Fig.6). This decrease may be due according to A. Boulal to the release of H^+ by the yeast during the consumption of NH^{+4} [5]. This is the results consistent with the literature of (5.5 to 4.5) [6,7]. After 20 hours there is a slight decrease in pH (4.26 to 4.30), the yeast still produces H^+ but the production of ethanol neutralizes the medium.

3.3. Sugar rate

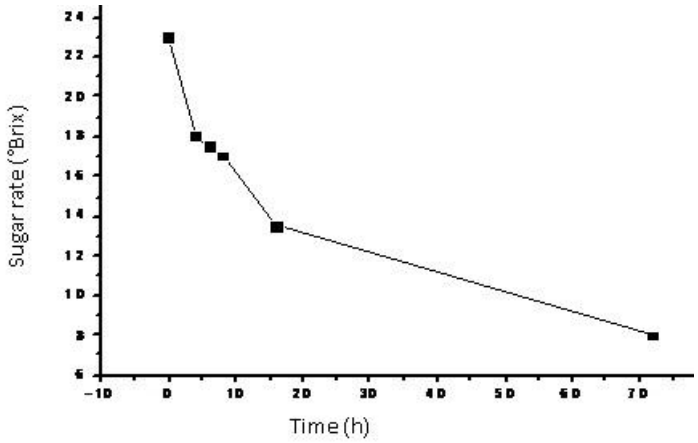

Fig.7. Sugars rate evolution

Yeast consumes sugar over time so the decrease of the sugar rate is logical. The figure 7 shows a rapid decrease in the level of sugars especially between 6 hours and 24 hours of fermentation.

This decrease is proportional to the amount of bioethanol produced. Even after 72 hours a very small amount of the infermentable sugar remains in the must which conform with the results obtained by Ould El Hadj [8].

3.4. Absorption at 490nm

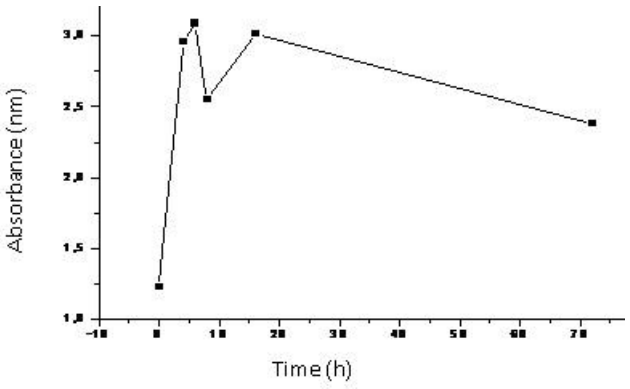

Fig.8. The absorbance of the must at 490 nm

The must of the dates during the fermentation has an absorption varies (figure 8), an increase can be due to the decomposition of the sugars then a decrease it is the result of the transformation of the sugars into bioethanol.

The degree of alcohol of the bioethanol obtained is 60 °, Boulal found a degree of alcohol between 60° and 80° [5], one can increase this degree by rectification or other dehydration techniques.

4. CONCLUSION

The fermentable sugars containing in dates variety Ghars of the region El oued in the south east of algeria can transformated into bioethanol by alcoholic farmentation, our kinetic study of this process (the evolution of the must density, the sugar rate, the pH and absorption of light at 490nm during fermentation) shows that:

• The density decreased by conversion of glucose to alcohol and loss of mass in the form of CO_2.

• A decrease in the rate of sugars from the first hours of fermentation because of their consumption by the yeast and after 6heurs by the ethanol conversion.

• The pH decreased rapidly from (5.62 to 4.24), this decrease may be due to the release of H^+ by the yeast during the consumption of NH^{+4}.

• The must of dates present a variable absorption of light at 490nm.

• The alcohol content of the bioethanol obtained is 60 °.

5. REFERENCES

[1] Kaidi F. and Touzi A. 2001. Production de Bioalcool à Partir des Déchets de Dattes. Rev. Energ. Ren. : Production et Valorisation – Biomasse, 75-78

[2] Oucif Khaled M.T. and Ladjel Segni. 2014. Production of bioethanol from varieties of dates of poor quality. African Journal of Agricultural Research. Vol. 9(37), pp. 2814-2818

[3] Gourchala F., Ouazouaz M., Mihoub F. and Henchiri C. 2015. Compositional analysis and sensory profile of five date varieties grown in south Algeria. Journal of Chemical and Pharmaceutical Research, 7(2):511-518.

[4] Mimouni Y., Siboukeur O. and Bayoussef Z. 2014. Fructose-rich syrup from Ghars cultivar dates (Phoenix dactylifera L.). Emir. J. Food Agric. 26 (11): 963-969.

[5] Boulal A., Kihal M. and Meknassi A. 2016. Etude du Pouvoir Fermentaire de Levures Isolées Naturellement à Partir des Dattes au Sud d'Algérie. Centre de Développement des Energies-, Faculté de Sciences, Université Oran -, 24 – 25.

[6] Borchani Chema, Souhail Besbes, Christophe Blecker, Manel Masmoudi, Rochdi Baati and Hamadi Attia. Chemical properties of 11 date cultivars and their corresponding fiber extracts. African Journal of Biotechnology Vol. 9 (26), pp. 4096-4105.

[7] El-Sharnouby Gamal A, Salah M Aleid and Mutlag M Al-Otaibi.2014. Liquid Sugar Extraction from Date Palm (Phoenix dactylifera L.) Fruits. J Food Process Technol 5-12

[8] Ould EL Hadj M. D., Cheick M., Hamidi W., Sayah Z., Bouaziz S. (2012). Etude comparative de la production d'éthanol brut à partir de trois variétés de dattes communes (Degla Beida, Tacherwit et Hamraya) reparties dans les différentes classes de dattes (molle, demi-molle et sèche) de la cuvette de Ouargla (Sahara septentrional Est algérien). Algerian journal of arid environment vol. 2, n° 2. 78-87.

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