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**Production of Bio ethanol from Sweet Sorghum
(*Sorghum bicolor L.*) Juice**

**A thesis submitted to the partial fulfillment the M.Sc Degree in Applied
chemistry**

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ABSTRACT

The use of fossil fuels contributes to global warming and there is a consequent need to resort to clean and renewable fuels. The production of biofuel from plant is becoming an attractive alternative to non-renewable fossil energy sources. Sweet sorghum is a very good alternative for bio-ethanol production to meet the energy needs of the country. Sweet sorghum is drought resistant, water logging resistant and saline-alkaline tolerant. Growing sweet sorghum for ethanol production is relatively easy and economical and ethanol produced from sweet sorghum is eco-friendly. the objective of this study was determine characterize of SSJ, ethanol production from sweet sorghum juice at optimized fermentation conditions and the effect of pH, yeast concentration (*saccharomyces cerevisiae*) and the time of fermentation on the ethanol yield and ethanol concentration. Standard methods were used to analysis sucrose, glucose and fructose content by HPLC method. The total titratable acidity was determined by titration against 0.1N NaOH to a phenolphthalein end point, the pH using a pH meter, while moisture, protein and ash content by AOAC methods. GC methods with external standards were used to qualitatively and quantitatively determine ethanol concentrations in final bio-ethanol for three samples 1,2and 3. The fructose, glucose and sucrose concentration averaged 37.84, 39.5 and 120.16g/l respectively, moisture content is 81.6%,ash content is 0.53%, protein content is 1.59% , total titratable acidity is 0.25% as malic acid and pH is 5.13. The initial pH of the fermented juice decrease with increase in time from 5.13 to 3.9 at the end fermentation. Ethanol yield increase with increase in time from 5.9% to 8.5% for 24 to 72 hours.

Ethanol concentration for three sample 1,2and 3 was 44%, 338.2% and 39.2% respectively. Obtained high ethanol yield and high final bio-ethanol concentration

for bio- ethanol yield was 8.5% and 44% respectively produce at (pH5, 2% yeast concentration and $30\pm 1^{\circ}\text{C}$ for 72 hours).

Keywords: Sweet sorghum, Fermentation, *Saccharomyces cerevisiae*, Bio-ethanol

الخلاصة

يساهم استخدام الوقود الإحفوري في ظاهرة الاحتباس الحراري في العالم ، وهناك حاجة الي استخدام أنواع وقود نظيفه ومتجدده. أصبح إنتاج الوقود الحيوي من النباتات بديلاً جذاباً لمصادر الطاقة الإحفورية غير المتجددة، وتعتبر الذره الحلوة بديل جيد للغاية لإنتاج الإيثانول الحيوي لتلبية إحتياجات الطاقة ،حيث يتمتع بخصائص جيده فهو مقاوم للجفاف والفيضانات كما انه مقاوم لقلوية وملوحة التربه وزراعته سهله وإقتصادية نسبيا ويعتبر إنتاج الإيثانول الحيوي من الذره الحلوه صديقاً للبيئة . تهدف هذه الدراسة لتحديد الخصائص الكيميائية للعصير المستخلص من سيقان الذره الحلوه ، إنتاج الإيثانول من تخمير العصير المستخلص بإستخدام خميرة الخبز عند ظروف تخمير (تركيز خميره 2% ، pH5 ، درجة حراره 30°C لمدة 72 ساعه)، دراسة تأثير تغيير ال (pH، تركيز الخميره والزمن) على إنتاج الإيثانول الحيوي ودراسة تأثير ال pH وتركيز الخميره على تركيز الإيثانول الحيوي المنتج. تم استخدام كروماتوغرافيا السوائل عالية الجودة لتحديد نسبة الفركتوز، الجلوكوز والسكروز في العصير المستخلص واستخدام كروماتوغرافيا الغاز لتحديد تركيز الإيثانول المنتج كما تم تحديد نسبة الرطوبة، الرماد والبروتين للعصير بطريقة (AOAC 1990). وجد تركيز الفركتوز، الجلوكوز والسكروز في العصير 37.84g/l ، 39.52g/l ، 120.16g/l على التوالي كما وجدت نسبة الرطوبة ،الرماد ،البروتين والحموضه بالمعايره 81.64% ، 0.53% ، 1.59% ، 0.25% على التوالي وكانت قيمة ال pH للعصير المستخلص 5.13 . تقل قيمة ال pH الإبتدائه للعصير المخمر مع الزمن من (5.13 إلى 3.9) من 24 إلى 48ساعه وتظل قيمة ال pH ثابتة حتى نهاية التخمير بينما يزيد إنتاج الإيثانول مع الزمن من (5.9% إلى 8.5%) من 24 إلى 72 ساعه. ووجد تركيز الإيثانول الحيوي لثلاثه عينات (3،2،1) هو 44% ، 38.2% ، 39.2% على التوالي . كما ان اعلى انتاج وتركيز للإيثانول الحيوي المنتج هو (8.5% ، 44%) على التوالي تم الحصول عليهما عند ظروف تخمير pH5 ، تركيز خميره 2% ، درجة حراره 30°C لمدة 72 ساعه.

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5.1 Conclusion

- One of the most critical criticisms of biofuels industry from plants is the threat to food security , but the use of sweet sorghum stalks for these purpose provides a good source of bio-ethanol production away from crops of nutritional importance.
- Sweet sorghum juice can an effective alternate raw material for ethanol production
- The effect of pH on fermentation process greater than the effect of yeast concentration.
- The optimal fermentation process condition pH 5 , 2% yeast

Concentration and $30\pm 1^{\circ}\text{C}$ for 72 hours.

5.2 Recommendation

- There is an urgent to support and commercialize the production of bio-fuel in order to get rid of the energy and to strengthen the economy of the country.
- The production of bio-ethanol will support sustainable development of renewable resources.
- The use of bio-ethanol with conventional vehicle fuels to provide a clean and cost effective environment.
- Bio-ethanol can be operated with gashol (petrol blended with ethanol) without any need for engine modification[39]
- Increase the biomass (sweet sorghum) and benefit from vast untapped land in the cultivation of sweet sorghum because of its good properties to combat desertification and the production of bio-fuels.