RICE BRAN OIL EXTRACTION USING ETHANOL AS SOLVENT IN PRETREATMENT PROCESS

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GENERAL INFORMATION

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KEYWORD

Extraction;
Ethanol solvent;
Rice bran oil;
Wax extraction.

ABSTRACT

This research was conducted to determine the alcohol concentration, alcohol immersion time and the ratio of raw materials /solvent to separate the highest amount of wax in rice bran before extracting rice bran oil. The treated rice bran was two processes. Process 1: rice bran – steamed – pickled ethanol – dry - extracted with hexane. Process 2: rice bran - pickled ethanol – dry - extracted with hexane. The treated rice bran was pickled ethanol in different ethanol 96, 90, 80, 70, 60, 50 and 40 respectively with raw materials/ solvent ratio of 1:5 (w/v). Rice bran was investigated for soaking time 15 minutes, 30 minutes, 1 hour, 2 hours, 3 hours respectively. After that, To select the appropriate alcohol content and soaking time were to investigate the ratio of raw materials/solvent 1:1 (w/v), 1:2 (w/v), 1:3 (w/v), 1:4 (w/v), 1:5 (w/v), 1:6 (w/v) and 1:7 (w/v) respectively. The results showed that the best soaking time to separate wax in rice bran was 3 hours with the ratio of raw materials/solvent 1:6 (w/v).

1. INTRODUCTION

Rice *(Oryza sativa)* bran is a by – product of milling in rice processing countries. The bran derived from rice grain during the whitening process is rich in protein, oil, and carbohydrate. It is normally used for extracting oil and as animal feed and a food ingredient. (P.Hanmoungjai et al., 2001). Rice bran comprises of 12 – 22% of oil, which contains high unsaturated fatty acids and bioactive phytochemicals (phenolic acids, flavonoids, gamma – oryzanol, tocopherols, and sterols) (Grosso et al, 2015, Pengkumsri et al, 2015).

The extraction of rice bran results in rice bran oil as a byproduct. Rice bran needs to undergo a process, in order to prevent the deterioration of fat and valuable bioactive compounds (P Loypimai et al., 2015). Many stabilization methods have been reported in the literature, such as steaming, ohmic heating (P Loypimai et al ., 2015, AM Matouk et al.,2009), ultrasound treatment (S Sayasoonthorn et al., 2012, WW Huang et al., 2013), parboiling, refrigeration and pH lowering (BMWPK Amarasinghe et al., 2009), and microwave radition (E Uquiche et al., 2008). There are several techniques used for the extraction of rice bran oil, including solvent extraction using

n – hexane, which is the most popular for commercial conventional extraction. The use of n – hexane in the conventional methods has some drawbacks, due to its flammability, toxicity, and the high temperatures involved in the process, resulting in some undesirable components in the oil as result of oxidative deterioration, the development of rancidity, and an off – flavor. Efforts have been made by many researchers to explore different, nonconventional techniques for oil extraction and utilization. Some of these methods are supercritical carbon dioxide extraction, subcritical water extraction, and enzyme – assisted extraction

However, there are no studies pretreatment of wax content in rice bran using ethanol as solvent before oil extraction. Therefore, the goal of the study investigated wax extraction method to replace cooling process. That helps to increase the efficiency of rice bran oil collection and reduce the use of chemicals and the time to refine the bran oil. Notably, the final oil exhibited light color and retained nearly 80 % of the oryzanol of raw oil. The yield of final oil reached 80–85 % through the entire refining process.

2. MATERIALS AND METHODS

2.1. Materials

Rice bran purchased Tan An city, Long An province and Cai Lay District, Tien Giang Province, It was steamed at 125 ± 5^0C for 10 min, in order to minimize lipase activity, and then dried in a hot air oven at 70^0C for 45 min. Then it was milled and separated by a 60 – mesh sieve (0.25mm) trainer. The final moisture content was 6 – 8%, after that rice bran was vacuum – packed and placed in a chiller at 5^0C for further analysis (Hamm et al., 2013)

n – Hexane (97%) – Model Xilong China.

H_3PO_4 (85%) – Korea

NaOH (99%) – China.

Ethanol (96%) – China

Magnetic stirrer – model Hana HI 190 M – 0 – 1000 rpm (IKA Works GmbH & Co. KG, Germany),

Natural convection oven – model TR240 (Memmert, Germany),

Spectrophotometer UV – Vis model NEUUV15 (Labomed, America),

Glass Soxhlet Extractor body and Graham Coil Condenser Lab Glassware – 1000ml

2.2. Determinations of physicochemical properties

2.2.1. Determination of protein content

The protein contents of the rice bran samples were estimated as percent total nitrogen by the Microkjeldahl procedure. Protein (%) was calculated by multiplying the per cent nitrogen by the fator 6.25 (AOAC. Official method and recommended practices of the AQCS. 4th)

2.2.2. Determination of moisture content

The moisture contents were determined by drying 3g of rice bran sample in a hot air oven maintaining temperature 105^0C (AOAC Official method 930.15)

2.2.3. Determination of fat content

Fat contents was estimated as crude ether extracts using moisture free samples. The solvent was removed by evaporation and the residue of fat was weighed (AOAC. Official method and recommended practices of the AQCS. 4th). Samples were carefully weighed to be 3g and were put in paper sleeves paved with fat free cotton, then dried at 90^0C for an hour. The dried samples were then placed in the dried and measurably weighed Soxhlet apparatus.

Extraction with petroleum ether was done after 6h. Solvent was then purified by distillation, and the extracts was dried at 105^0C until constant.

2.2.4. Determination of ash content

The ash contents of the samples were obtained by dry ashing the rice bran samples completely by heating it over a flame. This was expressed as g/100 g of each sample (AOAC. Official method and recommended practices of the AQCS. 4th)

2.2.5. Effect of extraction of solvents and extraction conditions on rice bran wax yield

The effect of soaking ethanol solvents, to extract rice bran wax was studied. Rice bran was extracted by using Soxhlet apparatus at 60^0C for ethanol concentration 40, 50, 60, 70, 80, 96 % (v/v) respectively, soaking time 15 mins, 30 mins, 1 hour, 2 hours, 3 hours respectively and the ratio of ricebran/ethanol (w/v) 1:2, 1:3, 1:4, 1:5, 1:6, 1:7 respectively. Wax yeild was determined by using the following equation:

$$\text{Wax yield (\%)} = \frac{wax\ content\ of\ sample\ after\ soaking\ ethanol\ (g)\times 1}{Weight\ of\ sample\ (g)}$$

2.2.2. Statistical analysis

Experiments were repeated 3 times. Results are presented as mean ± standard deviation, determined using Excel software. Differences between treatments were determined by ANOVA with 95% confidence (or p <0.05), using Minitab software version 10.

3. RESULTS AND DISSCUSIONS

3.1. Nutrient composition of rice bran

Table 1. Nutrient composition of rice bran

Composition (%)	Content (%)
Protein (%)	14.34 ± 0.34
Lipid (%)	15.75 ± 0.79
Moisture (%)	6.75 ± 0.67
Ash (%)	6.38 ± 0.52
Carbohydrate	45.52 ± 0.35

In table 1 showed that rice bran has a highly nutritious chemical composition. As a result. The protein content of rice bran was 14.34%, which was lower than hat obtained by Bhosale et al., 2015, with values of from 17.5 to 19.25% for stabilized and probiotic treated rice bran.

To prevent the growth of microorganisms, while prolonging sample stability, samples must be dried in a hot oven at 700C for 45 min after sieving and steaming. Sample were dried at a temperature of 105^0C for 3h in order to completely evaporate the water. Moisture content in rice bran was 6.75 which was slightly higher than that obtained by Bhosale et al., 2015 with values form 4.3 to 5.4. The analysis of ash content in the rice bran showed that ash content of rice bran in this study found at 6.38%. This value was higher than that obtained by Bhosale et al., 2015, with the values form 4.92 to 4.64. This might be due to the difference between untreated and treated rice bran samples.

3.2. Effects of steaming and non steaming to rice bran oil extraction

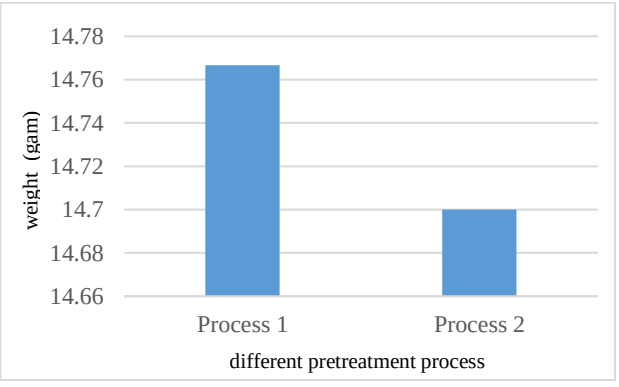

Fig 1. Average oil yield of the two processes.

The result showed that there is no significant difference between steaming and

non steaming on the extracted oil. The average drying time of both processes were 4 hours 30 minutes until the bran reaches 10% moisture. The average amount of oil obtained from the two processes were also the same about 14.7g (Figure 1). Therefore, the steaming to stretch the bran structure to make it is easier to extract rice bran oil similar to soaking in alcohol, that did not affect oil yield. So, Process 2 should be chosen to rice bran pretreament.

3.3. Effect of ethanol concentration on wax rice bran separation in preatreatment process

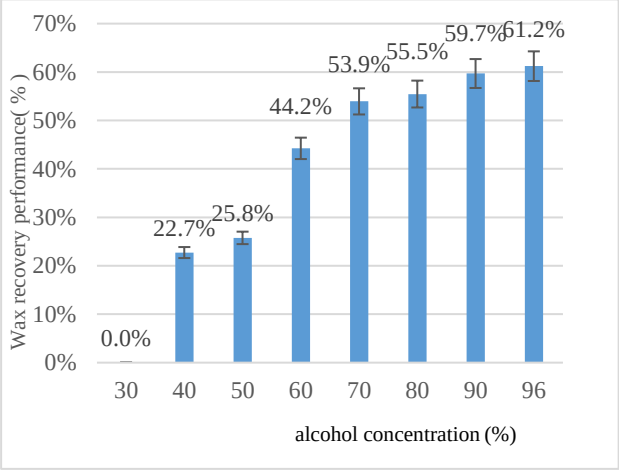

Fig 2. Wax recovery performance of different ethanol concentration

The highest amount of wax obtained at 96% v/v alcohol is 61.2% of the original wax. However, at an alcohol concentration 70% (v/v) and 90% (v/v), the obtained wax volume averages were 56.8% compare to average initial amount of wax. The amount of wax separated at 70% (v/v) alcohol concentration was 7.3% less than 26% that at alcohol concentration 96% (v/v) (Fig. 2). 70% alcohol was the best choice. This can be explained ethanol is a polar solvent, it is limited in how much it dissolves into anon-polar solute. However, rice bran might show dielectric properties, helping the ability to dissolve in polar solvent. The dielectric properties of grains and seeds vary with moisture content and bulk density, reported by ST Wara et al., 2019

3.4. Effects of alcohol soaking time on wax rice bran separation in preatreatment process

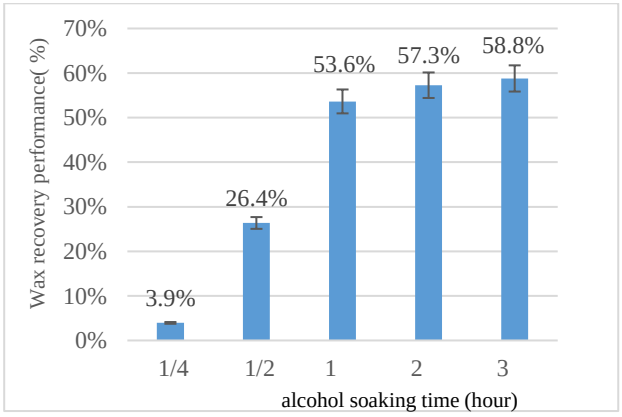

Fig 3. The amount of wax obtained by soaking time

As shown in fig 3. At 15 minutes, the wax separation was the least 5%. While the soaking time was over 1 hour, the bran solution had structural change. The results showed that when the alcohol immersion time increased by 3 times, the wax separation efficiency increased to 5.2% compared to the total wax, but it caused denaturation of the sample that created a strange odor. One hour immersion time was the best choice.

3.5. Effects of the ratio of rice bran/solvent (w/v) on wax rice bran separation in preatreatment process

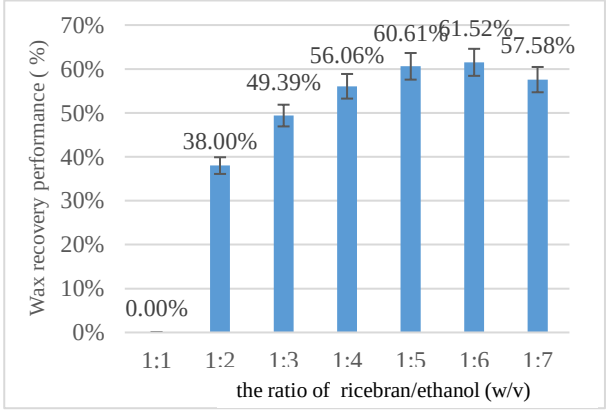

Fig 4. The amount of wax obtained by the ratio of rice bran/ethanol

As shown in fig 4. Alcohol – soaked rice bran was 1:1 (w/v) enough to wetting, it is

difficult for the filtration process. Alcohol – soaked rice bran was 1:3 (w/v) and 1:7 (w/v), the amount of wax separation on average about 60% compared with the initial total wax content in the bran. However, at 1: 3 (w/v) and 1: 4 (w/v), the mixture was in the paste state, it is difficult to filter process. By contrast, Settle process was difficult because the solvent was too much at 1:6 (w/v) and 1:7 (w/v). The ratio of rice bran/ solvent (1:5) (w/v) was the best choice.

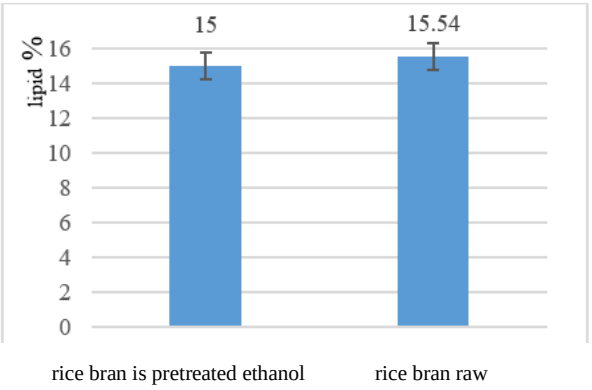

Fig 5. Lipid content was measured in bran before and after alcohol soaking.

The results of fig 5 showed that Alcohol – soaked rice bran were measured lipid and wax content, including 15.54g oil per 100 g of bran and 14.5 g wax per 100g of bran compared with the initial total wax content in the bran. It was showed that lipid content in bran after wax separation by alcohol was not change. So wax separation pretreatment using alcohol did not affect the amount of oil in the rice bran.

4. CONCLUSION

Research results showed that wax separation pretreatment using alcohol as solvent removed steaming process during rice bran oil extraction. Wax separation efficiency was soaked 70% (w/v) alcohol, the ratio of rice bran/solvent was (1:5) (w/v) with 1 hour soaking time. The results showed that Alcohol – soaked rice bran did not lose the oil content in rice bran.

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KHẢO SÁT QUY TRÌNH TIỀN XỬ LÝ CÁM GẠO BẰNG ENTHANOL TRƯỚC KHI CHIẾT XUẤT DẦU CÁM GẠO

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THÔNG TIN CHUNG

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TỪ KHOÁ

Ép dầu;
Dung môi ethanol;
Dầu cám gạo;
Chiết sáp.

TÓM TẮT

Nghiên cứu này xác định nồng độ cồn, thời gian ngâm cồn và tỷ lệ nguyên liệu/ dung môi tách lượng sáp trong cám gạo cao nhất trước ép dầu cám gạo. Cám gạo được xử lý hai quy trình. Quy trình 1: Cám gạo – hấp – ngâm ethanol – sấy khô – chiết bằng hexan. Quy trình 2: Cám gạo – ngâm rượu ethanol – sấy khô – chiết bằng hexan. Cám gạo đã qua xử lý được ngâm trong ethanol với các nồng độ ethanol khác nhau lần lượt là 96, 90, 80, 70, 60, 50 và 40 với tỷ lệ nguyên liệu/dung môi là 1:5 (w/v). Cám gạo được khảo sát với thời gian ngâm lần lượt là 15 phút, 30 phút, 1 giờ, 2 giờ, 3 giờ. Sau đó, để lựa chọn nồng độ cồn và thời gian ngâm phù hợp tiến hành khảo sát tỷ lệ nguyên liệu/dung môi 1:1 (w/v), 1:2 (w/v), 1:3 (w/v), 1 :4 (w/v), 1:5 (w/v), 1:6 (w/v) và 1:7 (w/v) tương ứng. Kết quả cho thấy thời gian ngâm để tách sáp trong cám gạo tốt nhất là 3 giờ với tỷ lệ nguyên liệu/dung môi 1:6 (w/v).