Value addition to rice bran oil as toilet soap

Wijayaratne T. D.[1], Munasinghe M.[1] and Wijayasiriwardana T. D. C. M. K. [2]*

Abstract

The oil extracted from rice bran is underutilized in Sri Lanka. It is a rich source of essential fatty acid linoleic acid. Linoleic acid is most favored in the production of cosmetic products for its emollient and moisturizing properties. The aims of this study were to extract rice bran oil from red, mixed and parboiled rice bran, prepare a composite crude rice bran oil sample, analyze crude composite oil for physicochemical characteristics stated in Sri Lanka Standard 1592: 2018, formulate rice bran oil enriched toilet soap and evaluate its compliance with the specifications mentioned in Sri Lanka Standard 34: 2009. Rice bran oil was extracted using hexane and composite crude rice bran oil was analyzed by methods mentioned in Sri Lanka Standard 313. Three trials were carried out for the formulation of a toilet soap by hot saponification reaction and methods in the International Organization for Standardization were followed to determine the characteristic requirements for the toilet soap. The highest oil yield (8.0%) was given by parboiled rice bran and composite rice bran oil showed 0.911 relative density, 1.456 refractive index, 103.122 g/100g of oil iodine value, 196.626 saponification value, 0.08% moisture and volatile matter, 16.0% free fatty acids and 30.0 meq/ Kg peroxide value. Trial 3 formulated soap showed 78.23 % total fatty matter, 1.8% matter insoluble in ethanol, 0.05% free caustic alkali and 0.2% total free alkali therefore complying with the requirements for a toilet soap.

Keywords: Rice bran oil, toilet soap, linoleic acid, total fatty matter

Introduction

Rice bran, a by-product of rice (*Oryza sativa*) milling is underutilized in Sri Lanka and is generally utilized as an animal feed. Rice bran is the cuticle between paddy husk and whole rice grain and contains 12-18% of oil which can be extracted by physical or chemical methods to acquire the value-added product rice bran oil (RBO) or rice oil [1]. RBO is renowned for its balanced fatty acid composition, and high levels of bioactive compounds such as γ-oryzanol, phytosterols, tocopherols, tocotrienols, squalene and several other nutrients. Due to its distinctive characteristics, RBO can be used for a variety of applications in both edible and non-edible forms. Lipase enzyme naturally present in rice bran is capable of hydrolyzing glycerides to free fatty acids and these free fatty acids together with phospholipids, glycolipids and waxes make crude RBO not suitable for direct consumption. However, free fatty acid-containing non-edible RBO can be incorporated into cosmetics, soaps, paints and detergents.

RBO is utilized as a raw material in personal care products such as soaps, shampoos and lubricants as a specialty ingredient for its cosmetic value. Essential fatty acid, linoleic acid (18:2) present in RBO in 28.0-53.4% content is capable of reducing trans-epidermal water loss thereby hydrating skin, preventing drying, scaling and cracking of the skin [2,3]. Linoleic acid shows emollient and moisturizing properties thereby helping in the healing process of dermatoses and sunburns and used for the treatment of *Acne vulgaricus.* In addition to linoleic acid, RBO is used as an ingredient in many cosmetics owing to

[1]*Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka.*
[2*]*Industrial Technology Institute, 503 A, Halbarawa Gardens, Thalahena, Malabe, Sri Lanka*

**Correspondence: Wijayasiriwardana T. D. C. M. K., Industrial Technology Institute, 503 A, Halbarawa Gardens, Thalahena, Malabe, Sri Lanka. Email: drchandima@iti.lk*

the presence of a variety of antioxidants.

Soap enrichment with RBO helps with retaining healthy skin while eliminating a variety of skin conditions. Therefore, the incorporation of crude RBO for soap production is a value-added way out for the underutilization of rice bran in Sri Lanka. The objectives of this study were to extract oil from three rice bran types in Sri Lanka, prepare a composite crude rice bran oil sample, analyze extracted composite crude RBO for physicochemical characteristics stated in Sri Lanka Standard (SLS) 1592: 2018, formulate a toilet soap enriched with RBO and evaluate its compliance with specifications mentioned for toilet soap in SLS 34: 2009.

Materials and methods

Rice bran collection

Parboiled rice bran, red rice bran and mixed (red and white) rice bran were collected from rice mills at Polonnaruwa, Rathnapura and Gampaha respectively though there are some factors such as soil, climatic technological borne differences limiting the oil yield comparison.

Rice bran oil extraction

About 200 g of bran sample was refluxed with 400 mL hexane at 65 ºC for 3 hours in a round bottom flask. After cooling, the solution was filtered with a Whatman filter paper. Hexane was recovered by rotary evaporation. Extractions were carried out four times from each bran sample. Each extracted crude RBO sample was weighed and collected in an air-tight glass reagent bottle to produce the composite crude RBO sample (Figure 1).

Fig. 1. Composite crude RBO

Analysis of composite crude rice bran oil

Composite RBO was tested in triplicates for the following identity and quality requirements as described in SLS 1592: 2018 according to related procedures in SLS 313.

Relative density was determined according to SLS 313-1-2: 2009.

Refractive index was determined according to SLS 313-1-5: 2017.

Iodine value was determined according to SLS 313-2-2: 2019.

Saponification value was determined according to SLS 313-2-1: 2014.

Moisture and volatile matter were determined according to SLS 313-3-5: 2016.

Free fatty acids were determined according to SLS 313-2-6: 2009.

Peroxide value was determined according to SLS 313-3-7: 2017.

Development of value-added rice bran oil incorporated soap

Three trials happened to be carried out by hot process via saponification reaction using NaOH lye since the first and second trials failed to meet the required TFM for toilet soap. Constituent fats and oils for soaps in Trial 1 are; RBO 30% and coconut oil 70%, in Trial 2; RBO 30% and castor oil 70%, in Trial 3; RBO 30%, castor oil 55%, lanolin 10% and beeswax 5%. The saponification value for oil blends in each trial was determined according to SLS 313-2-1: 2014 procedure. Lye solutions for each trial were prepared by dissolving respective amounts of NaOH (obtained through saponification analysis) in distilled water. Each oil blend was heated in a beaker on a heating mantle. When the temperature reached to 60 ºC lye solution was added and mixed for 20 minutes at 100 rpm using an overhead stirrer. After the completion of the saponification, the resultant sodium salt of the fatty acids which is known as the soap is transferred into a mold and left at room temperature to solidify overnight prior to total fatty matter (TFM) determination.

Determination of total fatty matter for the developed three soap formulations

TFM was determined for all three trials according to the test method mentioned in ISO 685-1975 and the method was triplicated.

Rest of the parameters mentioned in SLS 34: 2009 were conducted on the trial which produced a TFM level above 76.5%.

Analysis of soap

The following parameters were determined for the soap with TFM above 76.5%. The methods were carried out in triplicates.

Matter insoluble in ethanol was determined according to ISO 673-1981 (E).

Free caustic alkali was determined according to ISO 456-1973 (E).

Total free alkali was determined according to ISO 684-1974 (E).

Results

Rice bran oil yield

The average crude RBO yield obtained for parboiled rice bran, red rice bran and mixed rice bran are 8.0%, 6.6% and 5.2% respectively.

Analysis of composite crude rice bran oil

Results obtained for identifying characteristics of extracted crude composite RBO sample are; relative index at 25 ºC 0.911 ± 0.000, the refractive index at 28.7 ºC 1.456 ± 0.003, iodine value 103.122 ± 1.616 g/100g of oil, saponification value 196.626 ± 1.819.

Composite crude RBO sample showed moisture and volatile matter at 103 ± 2 Cº 0.08 ± 0.00 %, free fatty acids as oleic acid 16.0 ± 0.2 % and peroxide value 30.0 ± 0.7 meq/ Kg as results for quality characteristics.

Analysis of soap

TFM of Trial 1, Trial 2 and Trail 3 soaps were 53.12%, 66.67% and 78.23% respectively.

Table 1 depicts the characteristic requirements mentioned in SLS 34:2009 for toilet soap and the mean results ± standard deviation (SD) obtained for the respective characteristics of Trial 3 soap.

Table 1. Results are shown in Trial 3

Characteristic	Requirement in SLS 34: 2009	Mean result ± SD
TFM, including rosin acids, percent by mass, min	76.5	78.23 ± 0.18
Matter insoluble in ethanol, percent by mass, max	2.0	1.8 ± 0.1
Free caustic alkali, as NaOH, percent by mass, max	0.06	0.05 ± 0.01
Total free alkali, as NaOH percent by mass, max	0.3	0.2 ± 0.1

Discussion

Rice bran is considered a low-oil source. The oil recovery from a low oil source is typically carried out by solvent extraction. In this study, hexane was used as the solvent for RBO extraction as it is the most common and conventional solvent for commercial RBO extraction owning to its low price and high extractability. Due to the fact that rice variety, growth climatic conditions and milling processes the extractable oil yield of different rice brans are obviously varied. Albeit the results of the oil yield obtained for different brans revealed that parboiled rice bran gives a higher percentage of oil compared to raw bran (red and mixed). This is due to the phenomenon of outward migration[4]. Parboiling results in the release of oil in rice grains which facilitates the effective extractability of oil.

According to SLS 1592: 2018 the relative index, refractive index, iodine value and saponification value requirements for RBO must be 0.910-0.929, 1.460-1.473, 90-115 and 180-199 respectively. Results obtained for these characteristics were well within each identity range, confirming the extracted crude RBO's originality and authenticity. Similarly, if crude RBO is later used for edible purposes it must comply with the following quality requirements. The moisture and volatile matter at 103 ± 2 Cº should not exceed 0.5% and the result conforms to this requirement. The maximum free

fatty acid content of crude RBO should not exceed 10% whereas the study result surpasses this quality requirement for crude RBO. This high value could be attributed to the natural development of acidity as a result of lipase activity during storage prior to extraction. The maximum peroxide value of the extracted crude RBO must be 20 meq/ Kg. However, the increased result in the study might be attributed to the formation of oxidative products (mainly peroxides) during storage.

Soap is used as a cleansing agent on a daily basis and TFM is a quality parameter that is used to grade soaps. The high content of TFM is an indication of high-quality soap. According to SLS, TFM above 76.5% is considered good quality while TFM below 40% is the lowest acceptable soap safe for use. High TFM soap is capable of rehydrating and smoothening skin while acting as a lubricant owning to its high oil content [5]. The presence of unreacted lye lowers the TFM value degrading soap quality, consequently drying the skin. From the results obtained, Trial 3 soap is showing the highest quality owning to its 78.23% TFM value. Trial 1 and Trial 2 soaps can be regarded as bathing bars since the minimum requirement for a bathing bar is 40% according to SLS 1220: 2016. Trial 3 soap analysis results obtained for matter insoluble in ethanol, free caustic alkali and total free alkali were within the standard range further confirming its compliance to the toilet soap standard SLS 34: 2009 and therefore accepted as a toilet soap.

Conclusion

Trial 3 soap complies with the requirements mentioned in SLS 34: 2009. Hence, Trial 3 soap shall be regarded as toilet soap.

Acknowledgment

The authors gratefully acknowledge and thank Industrial Technology Institute for the facilities provided to conduct this study.

References

1. Wang, Y. (2019). Applications of Rice Bran Oil. In Rice Bran and Rice Bran Oil (Elsevier), p. 159–168.
2. Lautenschläger, H. (2003). Essential fatty acids — cosmetic from inside and outside. Beauty Forum, p.54–56.
3. Gopala Krishna, A.G., Hemakumar, K.H., and Khatoon, S. (2006). Study on the composition of rice bran oil and its higher free fatty acids value. *J Am Oil Chem Soc* 83, p.117–120.
4. Amarasinghe, B.M.W.P.K., and Gangodavilage, N.C. (2004). Rice bran oil extraction in Sri Lanka data for process equipment design. Food and Bioproducts Processing 82, p.54–59.
5. Selladurai, A., and Kathitesapillai, V. (2019). Preparation of Soaps by Using Different Oil and Analyze their properties. *Nat Prod Chem Res 7*, p.357.