The Pharma Innovation Journal 2023; 12(3): 400-406

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 400-406

www.thepharmajournal.com
Received: 02-01-2023
Accepted: 04-02-2023

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Formulation and development of the cookies using by-product of rice processing industry (Rice husk)

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DOI: https://doi.org/10.22271/tpi.2023.v12.i3d.18958

Abstract
This research project aims to evaluate the potential of rice husk and straw as an ingredient in the preparation of cookies. Rice husk and straw are agricultural by-products that are abundantly available and are typically discarded, causing environmental concerns. This study aims to explore the feasibility of using rice husk and straw as a partial or complete replacement for traditional cookie ingredients like flour and sugar. The research will involve developing different cookie formulations using rice husk and straw and conducting sensory evaluations to determine their acceptability. Additionally, proximate analysis of rice husk and straw will be conducted to determine their nutritional value and potential health benefits. The study will evaluate the chemical composition of these by products, including their carbohydrate, protein, fat, and fiber content, to determine their nutritional value. The results of this study will provide insights into the potential of rice husk and straw as a sustainable ingredient in the production of cookies, contributing to reducing waste and promoting circular economy. The findings of this research can also help in developing new food products that are not only tasty but also nutritionally beneficial for consumers.

Keywords: Cookies, rice husk, straw, environmental

Introduction

a. Waste as environmental hazard
Municipal solid waste (MSW) is a collection of waste generated by household, commercial and construction activities by individuals and collected and treated by local governments. Exponential population growth and urbanization, as well as socioeconomic development and rising living standards, are increasing the amount of municipal solid waste worldwide. On average, developed countries typically produce between 521.95 and 759.2 kg (kpc) per person per year, while developing countries typically produce between 109.5 and 525.6 kpc. According to recent estimates, global household waste generation exceeds 2 billion tons annually, posing a potential threat of environmental degradation.

b. Waste generation in world
Rapid urbanization has resulted in excessive expansion of the city's infrastructure services, including the city's solid waste management, due to inadequate resources and deficiencies in the existing system. Therefore, the expansion, operation, and maintenance of waste management systems in a sustainable manner by urban local bodies requires huge capital investment, cost-effective introduction of modern technology and public-private partnerships (PPP). You will need. In waste management and practices, reasonable waste management practices are required to prevent municipal waste from causing environmental pollution and health hazards.

c. Waste generation in India
In cities with populations of 1-50 million, waste generation per capita varies between 0.2 kg and 0.6 kg per day. Waste generation per capital increases by about 1.3% per year, and urban population increases by 3% to 3.5% per year, resulting in an annual increase in total urban solid waste of about 5%. Waste collection efficiency ranges from 50% to 90%. Urban Local Authorities (ULBs) spend Rs 500-1500 per tonne on solid waste treatment, of which 60%-70% is for collection only, 20%-30% for transportation and less than 5%. It is spent on very important treatment and disposal to avoid contamination. ULBs typically rely on crude oil dumping without adopting the scientific and sanitary approach of controlled dumping.

d. Rice waste

One of the consequences of industrial food production is the generation of large amounts of waste. Due to the large area of waste, disposal can be problematic and, if poorly managed, can pose environmental and health risks to residents. The rice industry is an important activity and produces a large amount of waste. The main solid wastes generated in the rice production cycle are straw, rice husks, ash, bran and broken rice. In the industrial process, each tone of processed paddy rice generates 200 kg of rice husk, 100 kg of rice bran and 140 kg of broken rice. Since rice, bran and broken rice are mainly used in the food industry, other waste has been intensively studied to find alternative solutions to landfill. Straw can be burned or used as animal feed. The husk can be used for poultry farming, composting, or incineration. For combustion, it was used as biomass to power a nuclear reactor to produce thermal or electrical energy in This process produces rice husk ash. This can be used as a by-product in various applications but is not yet solidified.

Material and methodology

The rice straw and husk were collected from a local mill and farm respectively in Jalandhar region of Punjab, India. The wheat flour used was acquired from food technology department of lovely professional university, Phagwara, Punjab. For cookie production the material used which were wheat flour, butter, sugar, milk ˚powder, baking soda, baking powder and vanilla essence were acquired from food technology department of lovely professional university, Phagwara, Punjab. Chemical used for the proximate analysis were petroleum ether, sodium hydroxide pellets, sulphuric acid, boric acid, ethanol, potassium sulphate, methyl red, bromocresol green were acquired from the labs of lovely professional university, Phagwara, Punjab.

Procedure

The procedure followed for the preparation of cookies by adding rice husk is as shown in flow chart 1

Ingredients used:

1. Wheat flour
2. Sugar
3. Coco Powder
4. Rice husk
5. Butter
6. Baking powder
7. Baking soda

Flow chart 1: Preparation of cookies

Sample preparation

There was a total of 11 sample of weight 50 gram each were prepared with different composition of rice husk and straw which were mixed with wheat flour in % composition of 2%, 4%, 6%, 8% and 10% of both and 1 sample of 100% of wheat flour.

Chemical Analysis

Proximate composition

a) Moisture estimation

Moisture content has lot to do with a meal product's traits, along with its physical look (shape, coloration, and so on.), texture, flavor, weight (that could impact the fee) in addition to elements that have an effect on the product's shelf-lifestyles, freshness, fine, and resistance to bacterial infection. A total of 11 samples were taken of weight 5 gm each with % composition of 2, 4, 6, 8 and 10 of rice husk and straw and a blank sample of wheat flour in a petri dish was taken and then kept in hot air oven for 110 °C for 24 hrs or until the reading became constant. We do this test to select the ideal % composition for cookie dough preparation as the most optimum moisture content reading will help us in selecting the perfect cookie dough mix.

$$\text{Moisture (\%)} = \frac{\text{Initial weight} - \text{final weight}}{\text{Total weight of sample}} \text{ X } 100$$

b) Ash

Total ash was established, claims A.O.A.C. (2005) [29]. Placed in a crucible after being precisely weighed (5 g), the sample was torched at a low flame until the entire substance had become smokeless. Following a 5-hour period at 550 °C in a muffle furnace, it was further cooled and weighed in desiccators. Ash was then calculated as a percentage after being measured in two consecutive weights until they were equal. The difference between weight start and weight end was used to compute the percentage of ash.

$$\text{Ash (\%)} = \frac{\text{Weight before heating} - \text{Weight after heating}}{\text{Weight of sample}} \text{ x } 100$$

c) Protein estimation

According to the approach described by (AOAC, 2005) [29], the Micro-Kjeldhal method was used to determine the protein content.

$$\text{\% N} = \frac{\text{CBR X Normality of } H_2SO_4 \text{ X Moles of Nitrogen X D.F}}{\text{Wt. of sample (g)}} \text{ X } 100$$

d) Fat estimation

Take a 5 g ground, dehumidified sample, weigh it precisely in a thimble, and then defat it with petroleum ether for 3–4 hours at 60 °C. After evaporating the resultant ether extract, the lipid content was determined (AOAC, 2005) [29].

Fat (%) = (Final weight of flask-Weight of empty flask) x 100/ weight of sample

e) Protein estimation

According to the approach described by (AOAC, 2005) [29], the Micro-Kjeldhal method was used to determine the protein content.

$$\text{\% N} = \frac{\text{CBR X Normality of } H_2SO_4 \text{ X Moles of Nitrogen X D.F}}{\text{Wt. of sample (g)}} \text{ X } 100$$

% Protein=% Nitrogen X 6.25

Where,

CBR= Sample burette reading – Blank burette reading

Normality of acid (H2SO4) = 0.01N

Moles of nitrogen= 14/1000

f) Carbohydrates

Carbohydrate determination is done here by difference method. Simple types of carbohydrates include sugars, whereas complex forms include starches and fibre.

Carbohydrate (%) = 100 - (% Moisture + % Ash + % Fat + % Protein)

Functional properties

a) Water absorption capacity

The formula used by Sowbhagya *et al*. to calculate the water absorption capacity was used (2007). 1 g of the material was accurately weighed into a test tube for graduate students, along with 30 ml of distilled water. After 18 hours of hydration at room temperature, the contents were centrifuged for 20 minutes at 4000 rpm to remove the suspended solution. A part of the wet sample was taken, weighed, and dried at 100 °C in order to obtain a constant weight. Sample grams of water-bound/gm was used to present the findings.

b) Oil sucking capacity

A pre-weighed centrifuge tube was filled with one gramme of flour mix (WS) (WT). Ten millilitres of oil were then poured into the tube to assess its ability to absorb oil. After being homogenised with a vertex mixer (Food technology lab, Lovely professional University), the suspension was allowed to settle at room temperature for 30 minutes. After that, the sample was centrifuged for 30 minutes at 3000 rpm (Food technology lab, Lovely professional University). After centrifugation, separated supernatant oil was discarded, and the centrifuge tubes were left upside-down on paper towels for five minutes to drain excess oil from the samples. Next, the samples were weighed (WF) to determine their ultimate weight. Equation 3.9 was used to compute oil absorption capacity (Du *et al*., 2014) [30].

Water Absorption Capacity/Oil Absorption Capacity= {Wf-(Ws + Wt)/Ws}100

c) Index of water solubility

Weighed (WS), one-gram flour sample samples were added to centrifuge tubes. It received 10 ml of deionized water and was homogenised for 1 minute with a vertex mixer (Food technology lab, Lovely professional University). After that, the mixture was centrifuged for 30 minutes at 3000 rpm (Food technology lab, Lovely professional University),). After centrifugation, the supernatant was collected in a pre-weighed drying dish (WD), dried for 24 hours at 60 °C, and the samples' final weights were noted (WF). The above formula was used to calculate the water solubility index (Du *et al*., 2014) [30].

Water Solubility Index (%) = {Wf-(Ws+Wd)/Ws}*100

Where WF stands for final weight, WS for sample weight, and WD for petri dish empty weight.

d) Bulk and tapped densities

The method described by Ungaro *et al*. was used to determine the bulk density (B) and tapped density (T) of the flour mix (2006). A known quantity of flour mixture (5 g) was used to fill a 10 ml measuring cylinder. After softly tapping the cylinder to remove any adherent particles and additional voids, the volume of the flour mixture was measured (Vi). The formula 3.15 was used to determine the BD. The sample volume (Vt) was read, the tapped density was calculated using the following equation, and the measurement was completed by tapping the measuring cylinder 300 times.

Bulk Density = (M/Vi)
Tapped Density = (M/Vt)

Where M is the mass of the flour mixture, and VI and VT, respectively, are the volumes at the initial and tapped conditions.

Results and Discussion

Moisture content

Moisture content is measured by heating the sample in hot air oven at 100-110 °C for 24 hours or until constant weight comes.

Table 1: Moistures Analysis

Moisture analysis (5GM sample)					
Type	wt. of empty petri dish (in gm) (w1)	wt. with sample (in gm) (w2)	After 1st hour (in gm)	Final reading (in gm) (w3)	Moisture content (in %)
Original sample	41.3	46.3	46	46	6
2% husk	33.3	38.3	38.2	38.2	2
4% husk	42	47	46.7	46.7	6
6% husk	42.6	47.6	47.3	47.3	6
8% husk	42.8	47.8	47.5	47.5	6
10% husk	42.5	47.5	47.4	47.4	2
2% straw	40.6	45.6	45.4	45.4	4
4% straw	45.1	50.1	50	50	2
6% straw	43.3	48.3	48.2	48.2	2
8% straw	41.8	46.8	46.5	46.5	6
10% straw	41.4	46.4	46.1	46.1	6

Table 2: Ash content

Ash content (2gm SAMPLE)				
Type	wt. of empty crucible (in gm) (W1)	wt. of crucible with sample (in gm)	Final reading (in gm) (W2)	Ash content (in %)
Original sample	21.26	23.26	21.3	2
2% husk	21.1	23.1	21.15	2.5
4% husk	20.36	22.36	20.41	2.5
6% husk	21.66	23.66	21.72	3
8% husk	22.05	24.05	22.12	3.5
10% husk	21.36	23.36	21.43	3.5
2% straw	22.37	24.37	22.4	1.5
4% straw	21.1	23.1	21.15	2.5
6% straw	21.28	23.28	21.31	1.5
8% straw	21.67	23.67	21.72	2.5
10% straw	20.36	22.36	20.43	3.5

Ash content followed an increasing order of the trend when percentage composition of rice husk. The increase that was observed was an increase of almost two fold at 10% substitution of rice husk in the cookies that were developed. In case of rice straw gradual increase was observed as well at the 2% composition and 10% composition an increase of more than 2 times was present in the cookies that were prepared.

Table 3: Fibre

Fibre (4GM sample)					
Type	wt. of empty (gm)	wt. of crucible with wet sample (in gm)	wt. of crucible with dry sample (in gm) (W2)	wt. of crucible after furnace (in gm) (W3)	Final reading (in %)
Original sample	17.64	18.59	17.68	17.66	0.5
2% husk	21.53	21.78	21.55	21.54	0.5
4% husk	20.3	21.27	20.41	20.33	2
6% husk	21.53	23.06	21.71	21.55	4
8% husk	21.53	23.46	21.78	21.55	5.75
10% husk	21.53	23.65	21.82	21.57	6.25
2% straw	21.53	22.61	21.59	21.55	1
4% straw	21.14	23.36	21.27	21.19	2

6% straw	20.16	23.29	20.42	20.29	3.25
8% straw	19.35	23.31	19.53	19.37	4
10% straw	17.69	22.47	17.98	17.79	4.75

Table 4: Fat Extraction

Fat extraction (5 GM sample)	
Type	Wt. Of empty bulb (in gm)
original sample	113.87
2% husk	105.72
4% husk	114.26
6% husk	113.8
8% husk	106.42
10% husk	114.26
2% straw	155.66
4% straw	113.8
6% straw	105.57
8% straw	113.72
10% straw	154.06

Table 5: Bulk Density

Bulk density		
Sample	**(10 g) in 50 ml flask**	**Bulk density (g/cm^3)**
Straw Flour	27.00 ml	0.37
Husk Flour	36.00 ml	0.27
Wheat Flour	14.00 ml	0.71
Husk 4%	15.50 ml	0.64
Husk 6%	16.00 ml	0.62

Table 6: Trapped Density

Tapped density		
Sample	**(ml) in 50ml flask**	**Tapped density (g/cm^3)**
Straw Flour	28.00 ml	0.35
Husk Flour	22.50 ml	0.44
Wheat Flour	12.00 ml	0.83
Husk 4%	13.00 ml	0.76
Husk 6%	12.50 ml	0.8

Table 7: Water Absorption

Water absorption					
Sample	**w.t of empty tube (in grams)**	**w.t of tube with flour (in grams)**	**w.t of tube with flour and water (in grams)**	**w.t of tube after centrifuge (in grams)**	**%Absorption**
Husk Flour	7.22	7.72	17.74	9.13	18.26%
Straw Flour	6.9	7.4	16.83	9.11	23.10%
Wheat Flour	6.84	7.04	17.26	7.91	12.35%

Table 8: Oil Absorption

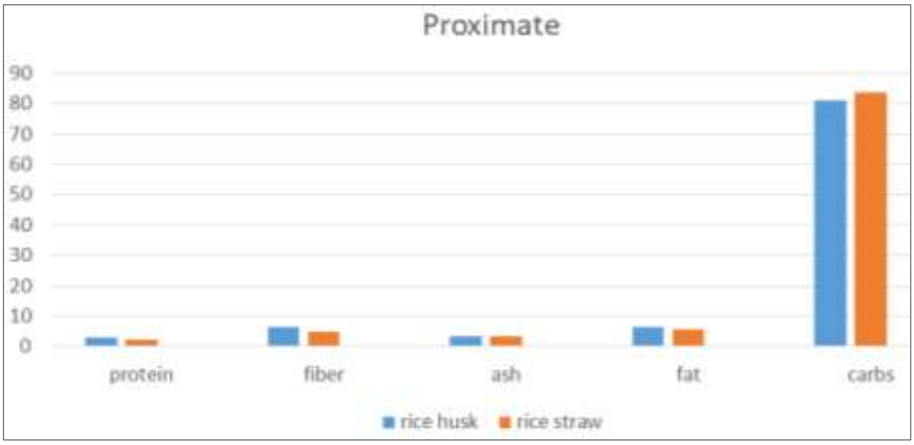
Oil absorption					
Sample	**w.t of empty tube (in grams)**	**w.t of tube with flour (in grams)**	**w.t of tube with flour and oil (in grams)**	**w.t of tube after centrifuge (in grams)**	**%Absorption**
Husk Flour	6.83g	7.33g	15.78g	8.13g	10.91%
Straw Flour	7.70g	8.20g	16.66g	10.10g	23.17%
Wheat Flour	7.74g	8.24g	16.97g	9.66g	17.23%

Quality analysis of cookies

Physical properties of developed cookies: The developed cookies were analysed for the physical properties such as spread ratio, colour, and texture with a standard method described in the Supplementary Material.

Composition of developed cookies

The proximate composition, mainly protein, fiber, and ash content of cookies were analysed using the standard method described by Theagarajan *et al*. [20]. (Shimadzu Corporation, Kyoto, Japan).



Graph 1: Proximate Analysis

Conclusion

This study has demonstrated that rice husk, a by-product of rice, can be utilized in the preparation of cookies as a functional ingredient. The proximate analysis of the cookies revealed that they were rich in dietary fiber, which can aid in digestion and promote overall health. Additionally, the functional properties of the cookies, such as their water absorption capacity and oil retention capacity, were found to be improved by the addition of rice husk. Therefore, incorporating rice husk into cookie recipes could be a viable means of adding nutritional value to a popular snack food while reducing food waste. Further research could investigate the sensory properties of rice husk-enriched cookies and assess consumer acceptance of these products. Overall, this study highlights the potential of using agricultural by-products to create innovative, sustainable, and nutritious food products.

References

1. Alam R, Chowdhury M, Hasan G, Karanjit B, Shrestha L. Generation, storage, collection and transportation of municipal solid waste: A case study in the city of Kathmandu, capital of Nepal. Waste Management. 2008;28(6):1088-1097.
2. Al-Yousfi B. Sound Environmental Management of Solid Waste: The Landfill Bioreactor. UNEP. Asase, M., E. Yanful, M. Mensah, J. Stanford, S. Amponsah. Comparison of municipal solid waste management systems in Canada and Ghana: A case study of the cities of London, Ontario, and Kumasi, Ghana. Waste Management. 2009;29(10):2779-2786.
3. Asomani-Boateng R, Haight M. Reusing organic solid waste in urban farming in African cities: a challenge for urban planners. In Urban Agriculture in West Africa: Contributing to Food Security and Urban Sanitation. O. Smith (Ed.). IDRC; c1999.
4. Atudorei A. Integrated Municipal Solid Waste Management in Romania. Case Study - Region 8 - Bucharest - Ilfov. European Federation of Waste Management and Environmental Services.
5. Alexandratos N, Bruinsma J. World agriculture towards 2030/2050: The 2012 revision. ESA Working paper No. 12–03. Rome, FAO; c2012.
6. Alfaro EF, Dias DB, Silva LGA. The study of ionizing radiation effects on polypropylene and rice husk ash composite. Radiation Physics and Chemistry. 2013;84:163-165.
7. Almeida RS. Pirólise rápida de casca de arroz: estudo de parâmetros e caracterização de produtos. Master Dissertation in Materials Science, Federal University of Rio Grande do Sul, Porto Alegre, Brazil. Amarasinghe BMWPK and Gangodavilage NC (2004) Rice bran oil extraction in Sri Lanka data for process equipment design. Food and Bioproducts Processing. 2010;82:54-59.
8. Armesto L, Bahill A, Veijonen K, *et al*. Combustion behavior of rice husk in a bubbing fluidised bed. Biomass and Bioenergy. 2002;23:171-179.
9. Ávila VS, Oliveira U, Figueredo EAP, *et al*. Avaliação de materiais alternativos em substituição à maravalha como cama de aviário [Alternative material to replace wood shavings as broiler litter]. Revista Brasileira de Zootecnia. 2008;37:273-277.
10. Bevilaqua DB, Rambo MKD, Rizzetti TM, *et al*. Cleaner production: levulinic acid from rice husks. Journal of Cleaner Production. 2013;47:96-101.
11. Bhattacharya AK, Mandal SN, Das SK. Adsorption of Zn (II) from aqueous solution by using different adsorbents. Chemical Engineering Journal. 2006;123(1-2):43-51.
12. Bhattacharya AK, Naiya TK, Mandal SN, *et al*. Adsorption, kinetics and equilibrium studies on removal of Cr (VI) from aqueous solutions using different low-cost adsorbents. Chemical Engineering Journal. 2008;137(3):529-541.
13. Binod P, Sindhu R, Singhania RR, *et al*. Bioethanol production from rice straw: An overview. Bio-resource Technology. 2010;101(13):4767-4774.
14. Bishnoi NR, Bajaj M, Sharma N, *et al*. Adsorption of Cr(VI) on activated rice husk carbon and activated alumina. Bioresource Technology. 2004;91(3):305-307.
15. FAO. Food and Agriculture Organization of the United Nations (Trade and Markets Division); c2012. Available at: http://www.fao.org/economic/est/ publications/rice-publications/ricemarket-monitor-rmm/en/ (accessed 20 December 2013).
16. FAO. Food and Agriculture Organization of the United Nations. FAO Statistical Yearbook 2013. Rome: World Food and Agriculture, FAO; c2013.
17. FAOSTAT. Food and Agriculture Organization of the United Nations Statistics. Food and Agricultural commodities production; c2012. Available at: http://faostat3.fao.org/faostat-gateway/go/to/download/

null/QC/E (accessed 3 February 2014).
18. Municipal Solid Waste Generation, Composition, and Management: The World Scenario Tanmoy Karak, R. M. Bhagat & Pradip Bhattacharyya.
19. Prasad CS, Maiti KN, Venugopal R. Effect of rice husk ash in whiteware compositions. Ceramics International. 2001;27(6):629-635.
20. Oyenuga VA. Nigeria Feeds and Feeding Stuffs. Ibadan University Press. 3rd Edition; c1998.
21. Aderolu AZ, Iyayi EA, Onilude AA. Changes in nutritional value of rice husk during Trichoderma viridedegradation. Bulgarian Journal of Agricultural Science. 2007;13(5):583-589.
22. Vadiveloo J, Nurfarza B, Fadel JG. Nutritional improvement of rice husk Animal Feed Science and Technology. 2009;151:299-305.
23. Dairo FAS, Umeh DC, Oluwasola TA, Adegun MA. Utilization of fermented corn cob and caged layers manure mixtures by weaners' rabbits. Nigerian Journal of Animal Science. 2010;12:63-71.
24. Beg S, Zafar SI, Shah FH. Rice husk biodegradation by Pleurotus ostreatus to produce a ruminant feed. Agricultural. Wastes. 1986;17(1):15-21.
25. Dairo FAS, Egbeyemi OB. Response of weaner rabbits to diets containing Fermented mixtures of cassava peel and dried caged layers manure. African Journal of Agricultural Research. 2012;7(49):6588-6594.
26. Abraham AK, Mathew R Sindhu, Pandey A, Binod P. Potential of rice straw for bio-refining: An overview. Bioresource Technology. 2016;215:29-36.
27. Naiya TK, Bhattacharya AK, Sailendranath Mandal S, *et al*. The sorption of Lead (II) ions on rice husk ash. Journal of Hazardous Materials. 2009;163(2-3):1254-1264.
28. Madhiyanon T, Sathitruangsak P, Soponronnarit S. Combustion characteristics of rice-husk in a short-combustion-chamber fluidized-bed combustor (SFBC). Applied Thermal Engineering. 2010;30(4):347–353.
29. AOAC. Official Methods of Analysis. 18th edn. Association of Official Analytical Chemists; Arlington, VA, USA; c2005.
30. Chen J, Wang F, Liu Q, Du J. Antibacterial polymeric nanostructures for biomedical applications. Chemical communications. 2014;50(93):14482-14493.