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Research Article

Effect of Extrusion and Flavor Addition in the Formulation of Choco Rice Flakes

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Abstract

The investigation focused on the effect of extrusion process and flavor addition of a developed ready to eat chocolate-coated rice flakes. Flaked products are very popular ready to eat traditional product prepared by toasting/frying and seasoning in rice consuming countries particularly in India. Rice (*Oryza sativa L.*) is the common food for two-thirds of the world population and it is the most important cereal crop cultivated in the global. The chocolate coated rice flakes were prepared by mixing of ingredients are rice flour, cocoa powder and icing sugar at different ratios (T1=2:1:1; T2=3:1:1; T3=4:1:1; T4=5:1:1) which is flanked by using heavy-duty cereal roller flaker. The developed chocolate-coated rice flakes are used for identification of effect of extrusion and flavor addition on the textural, sensory and flaking characteristics of the developed product. Results revealed that hardness (T2=0.52Kg/Sq.cm) were decreased whereas flaking length (2.5-4.8cm) and yield (75.8%) were increased in T2 sample than other ratios (T1=0.88Kg/Sq.cm, 1.8 -2.6cm, 15.12%; T3=0.82Kg/Sq.cm, 2.1-2.5cm, 66.67% and T4=0.73Kg/Sq.cm, 1.8-2.2cm,

21.17%) respectively. According to sensory result, the overall acceptability was higher in T2 sample compared to other samples (T1, T3 and T4).

Introduction

Rice (*Oryza sativa L.*) is the most important cereal crop and consumed as stable food for two-thirds of the world population [1]. Production of paddy in the world around 660 million tonnes, out of which India produces around 144.6 million tonnes in that 14.46 million tonnes (10% of production) were being used for the production of rice products like popped, expanded and flaked rice [2, 3]. Importantly about one-fifth of the rice produced is converted into flakes [4]. Over 85% of the flaked rice were produced in the traditional tiny-scale production units in India [5]. Flaked rice or popularly known as "Poha" is a most popular processed rice product consumed as a breakfast cereal particularly semi-urban, rural areas and middle class families of urban India, which is substitute as snack food instead of cereal in weaning foods [Gokul] [6]. Low energy and protein intakes are most common nutritional problems for people in rice consuming countries. In addition, micronutrient deficiencies include iron deficiency (aneamia), vitamin A deficiency and iodine deficiency common in rice consuming countries [7]. The overall occurrence of aneamia is highest in developing countries such as South Asia and Africa. Ready to eat breakfast cereal products particularly rice-based products are a perfect food vehicle for macro and micronutrient fortification because it is usually made with low fat and high fiber content [8].

Ready-to-eat (RTE) breakfast cereals are processed grain formulations suitable for human consumption without further cooking in the home. They are relatively shelf stable, lightweight, and convenient to ship and store. They are made primarily from corn, wheat, oats, or rice in about that order of the quantities produced, usually with added flavor and fortifying ingredients. Flattened rice can eat raw by immersing it in plain water or milk, with salt and sugar to taste, or lightly fried in oil with nuts, raisins, cardamons and other spices. It can be reconstituted with hot water to make a porridge or paste, depending on the proportion of water added. In villages, particularly in Chhattisgarh, flattened rice can eat as raw by mixing with jaggery. The physicochemical and rheological properties of rice have been changed during roasting, parboiling and flaking process due to gelatinization of starch occurred [3]. Flaking caused further damage of starch due to application of mechanical force, changes being higher in flakes from roller-flaker as compared to those from edge-runner.

The addition of flavoring ingredients into the RTE breakfast cereal such as cocoa powder, strawberry, lemon, mint, garlic and cinnamon having functional components in it which impart health benefits when consumed. Cocoa contributes various minerals like magnesium, phosphorus and potassium need for the specific function of the body's various systems. Quality dark chocolate and cocoa powders contain high amounts of the mineral magnesium [9].

The term chocolate refers to the combination of cocoa, cocoa butter, sugar into a solid food product. Cocoa beans and cocoa-containing products are rich source of dietary polyphenols [10, 11, 12]. Recently, polyphenols present in chocolate have gained much more attention, owing to their antioxidant capacity (free

free radical scavenging and metal chelating) and their possible beneficial implications in human health, such as in the treatment and prevention of cancer, cardio vascular disease, atherogenic, ulcer, thrombotic, and other pathologies (Jan Wollgast and Elke Anklam, 2000). Cocoa is rich in polyphenols particularly in catechins (flavan-3-ols) and procyanidins. Catechin is a flavan-3-ol, a type of natural phenol and antioxidant. It is a plant secondary metabolite and part of the chemical family of flavonoids. Flavonoids may be beneficial in the prevention of cancer, cardiovascular and neurodegenerative diseases. Cocoa and chocolate products have the highest concentration of flavonoids among commonly consumed foods and have many health promoting properties. Over 10 percent of the weight of cocoa powder is flavonoids. Catechin and epicatechin are abundant, naturally occurring flavonoids from the class known as flavanols. Cocoa products, berries, apples, tea and red wine are among the richest dietary sources. Cocoa and chocolate are among the most concentrated sources of the procyanidin flavonoids, catechin, and epicatechin. Cocoa powders may be significant iron sources for human subjects. Cocoa and chocolate products are rich in flavanol monomers, oligomers, and polymers (procyanidins) [13]. Cocoa and chocolate products have the highest concentration of flavonoids among commonly consumed foods and have many health promoting properties. Over 10 percent of the weight of cocoa powder is flavonoids [14]. Three main groups of cocoa polyphenols can be distinguished namely the catechins (37%), anthocyanins (4%) and proanthocyanidins (58%) [15]. Important of the study is processing of flakes from rice requires roasting of paddy during which the grains get popped and gave less yield of flaking and rice millers expressed their need to develop flakes directly from rice flour to minimize the flaking loss and to add flavor to rice flakes. The main purpose of the present work is to study the impact of extrusion and flavor addition in processing rice flakes from rice flour.

Materials and Methods

Collection of Rice Variety

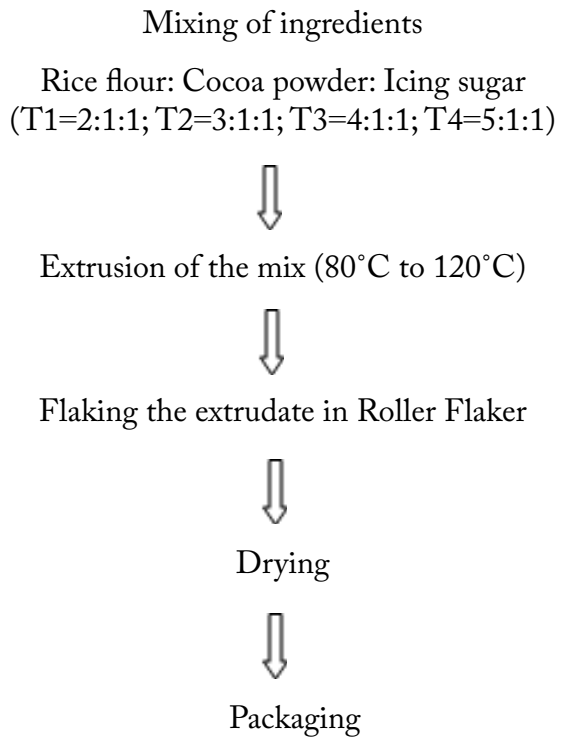
Co 1009 rice variety was collected from Thangavilas rice flakes manufacturing industry located at Kumbakonam, Tamil Nadu that is rich in amylase content. Rice flakes were prepared by method of Mujoo R. *et al.,* (1998) [3] using heavy-duty cereal roller flaker available at Food Products Bussiness Incubation Centre (FPBIC).

Reagents and Chemicals

All chemical analysis and HPLC grade solvents (acetonitrile, methanol, and orthophosphoric acid) were purchased from Ponmani Chemicals, Tiruchirapalli.

Formulation of Choco Rice Flakes

Mujoo R. *et al.*, (1998) methods were adopted [3]. The selected rice variety was made into flour using mini flour mill. The flour was mixed with icing sugar, cocoa flour in the ratios of 2:1:1 (T1), 3:1:1 (T2), 4:1:1 (T3) and 5:1:1 (T4). The mix was extruded at 120°C and the extrudate was flaked into roller flaker. The flakes were dried in tray drier to bring moisture of 11%. After drying the samples were packed and stored.



Flow diagram showing processing of Choco Rice Flakes

Flaking Length

Flaking length was calculated by using vernier caliper to the accuracy of 0.001mm [16].

Hardness

Hardness of the sample was determined by crushing method using a TA-XT2 Texture Analyzer. The maximum peak value indicating first crack of product at a one point was recorded and the obtained value was used as a measurement for hardness [16,17].

Flaking Yield

After flaking process, the flaked rice was thoroughly cleaned for husk and bran. The cleaned choco rice flakes was separated into whole and broken [5]. Broken and dust were separated from good dried flakes by sieving with 2 mm perforations. Husk separation of the dried sample was done manually, to measure the flaking efficiency. Weight of the samples was measured by the electronic balance. Flaking efficiency and breakage percentage was calculated using the formula given below

$$\text{Flaking Efficiency} = \frac{\text{Amount of good flakes}}{\text{Amount of paddy sample}} \times 100\%$$

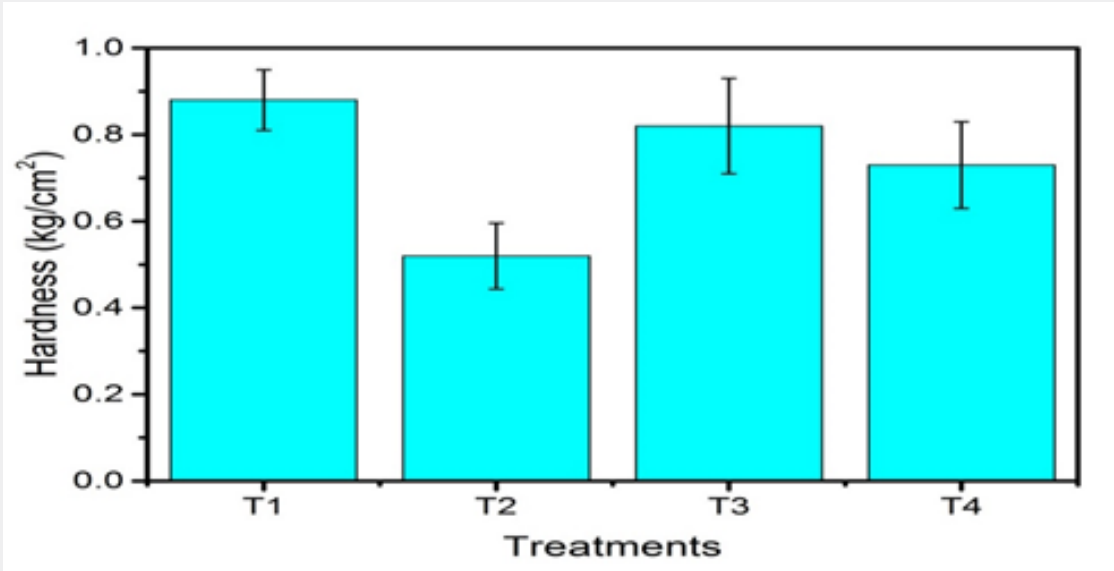
Sensory Evaluation of Developed Rice Flakes

Sensory characteristics like appearance and color, sensory texture, odor, flavor and taste and overall acceptability was evaluated for all the rice flakes samples using nine-point hedonic scale, [17].

Results

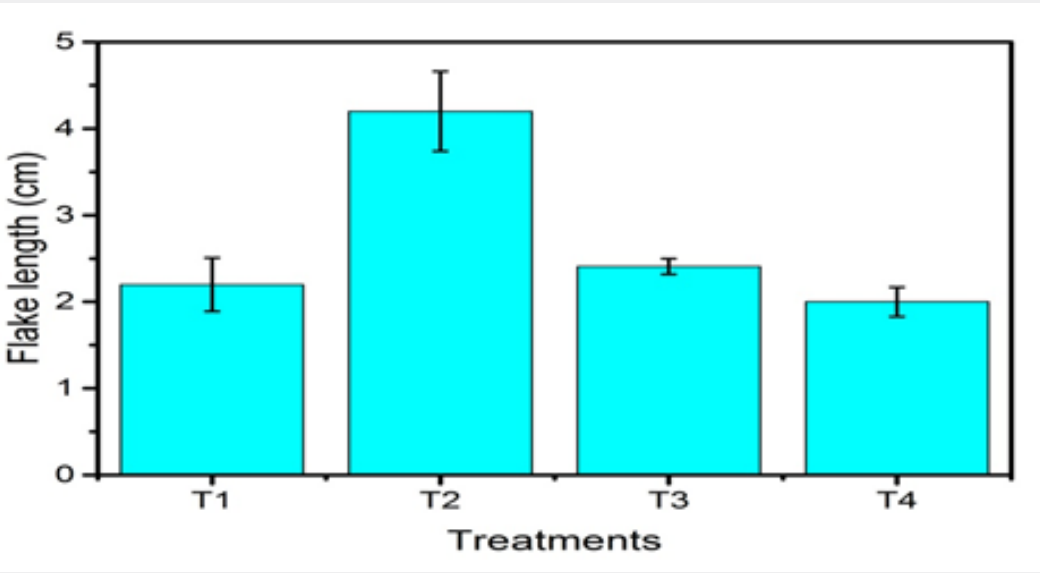
Hardness

Hardness is important textural attributes used along with other mechanical parameters such as firmness, resistance, toughness, stiffness and rigidity. Hardness is the maximum compression force (N) applied for the breakdown of samples in the deformation curves varied significantly on level of processing leading to obtain the choco flaked rice [15]. Hardness value of choco rice flakes varied from 0.52 to 0.88 (Kg/Sq.cm). Minimum hardness was found at ratio of 3:1:1. The change in hardness of grains may be attributed to the effect of rice concentration, flavor addition and further the mechanical compression to flattened form having many surface cracks or the damaged matrix appears on surface of the flaked rice [20].



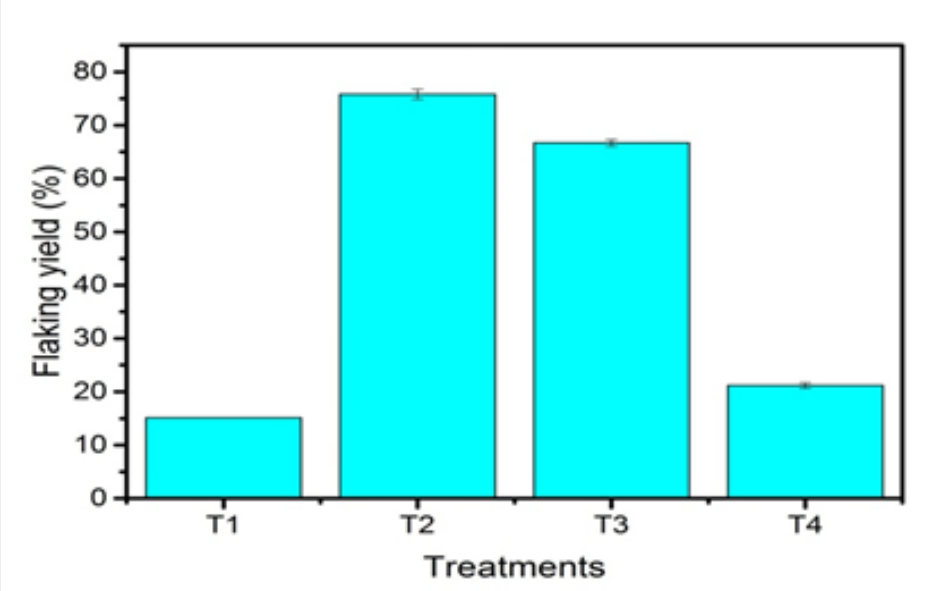
Flaking Length

Rice contains rich in starch, which composed of amylose or linear molecule and amylopectin or branched molecule. T3 and T4 contain higher rice proportion, which produce thicker flakes due to higher amylase content. T1 also had lower flaking yield this may due to no sufficient starch molecule present in that. T2 sample have good flaking length compared to other treatments.



Flaking yield

Flaking yield of choco rice flakes higher in T2 (75.8%) followed by T3 (66.7%). T1 (15.12%) and T4 (21.17%) has low flaking yield due to increase in proportion rice flour. Because rice flour is rich in starch content which affect the flaking yield of choco rice flakes. Higher the starch content lowers the flaking content both are directly interrelated.



Overall acceptability

Sensory analysis was conducted with 15 panel members using nine-point hedonic scale. The overall acceptability values of choco rice flakes ranged from 2.3 to 8.5. Highest overall acceptability was found at the ration of 3:1:1 for soaking time of 5-7 minutes.

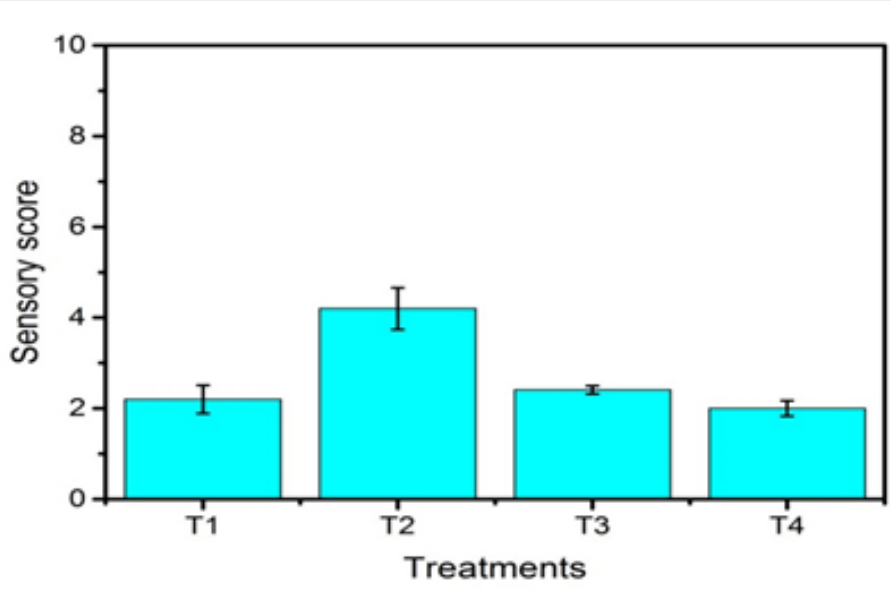


Table 1: *Effect of extrusion and flavor addition on physical properties of the developed rice flakes*

Treatments	Soaking time (min)	Hardness (Kg/Sq.cm)	Flake length (cm)	Flaking yield (%)	Sensory score
T1	7-10	0.88 ± 0.07	1.8 to 2.6	15.12 ± 0.06	2.3±0.9
T2	3-4	0.52 ± 0.076	2.5 to 4.8	75.8±0.94	8.5 ± 0.5
T3	5-7	0.82 ± 0.11	2.1 to 2.5	66.7 ± 0.62	3.4 ±0.8
T4	5-7	0.73. ± 0.10	1.8 to 2.2	21.17 ± 0.51	2.6±1.1

Discussion

The hardness of the extrudate affected the flaking property and flaking yield. Hardness was found to be less for the variation T2. The flaking yield was found to be 75% for T2, which is higher than other treatments, and the time taken for soaking was minimum. The sensory score for overall acceptability of the choco rice flakes was higher in T2 than other treatments. The sample T2 had a minimum hardness when compared

with other treatments. The sample when pressed in the roller flaker gave flakes of an average length of 2.5 to 4.8cm whereas other samples namely T1, T3 and T4 gave an average length of 1.8 to 2.5cm. The flakes made from T2 sample was firm and gave an average yield of 75.8%. The yield was found to be minimum for the variation T1 due to higher content of cocoa powder which gave very harder and sticky extrudate. The sample T2 scored higher sensory values for texture, taste and overall acceptability of 8.5 in 9-point headonic rating scale. Based on the physical and sensory analysis, the rice flakes made from the ratio 3:1:1 was found to be acceptable.

Conclusion

Choco rice flakes are produced directly from rice flour and not from paddy, which was well received by rice millers as the technology gave a good yield, compared to conventional method of flaking. The product can be used as RTE breakfast food soaked in milk or a snack food. The product T2 variation has lesser hardness and higher overall acceptability, flaking yield and flaking length compared to other variation. This is because effect of ingredient variation, flavor addition and mechanical damage during extrusion and flaking. Flavor added choco rice flakes has good marketing potential, economical and consumer acceptability.

Bibliography

1. Jouki, M. & Khazaei, N. (2012). Some physical properties of rice seed (Oryza sativa). *Res J Applied Sci, Eng Tech., 4*(13), 1846-1849.

2. Chitra, M., Singh, V. & Ali, S. Z. (2010). The effect of processing paddy on digestibility of rice starch by in vitro studies. *J Food Sci Tech., 47*(4), 414-419.

3. Mujoo, R., Chandrashekar & Ali, S. Z. (1998). Rice protein aggregation during the flaking process. *J Cereal Sci., 28*(2), 187-195.

4. Narasimha, H. V. (1995). Value addition to food grains through food processing: A CFTRI approach. *CFTRI Annual Report*, 68-72.

5. Shinde, G. & Durgadevi, M. (2017). Development of Iron Fortified Chocolate Flavoured Rice Flakes. *Nutr Food Sci., 8*(1), 649.

6. Dexter, P. B. (1998). Rice fortification for developing countries, OMNI/USAID.

7. Steiger, G., Muller-Fischer, N., Cori, H. & Conde-Petit, B. (2014). Fortification of rice: technologies and nutrients. *Annals of the New York Academy of Sciences, 1324*(1), 29-39.

8. Dyer, K. A. (2006). The many health benefits of dark chocolate.

9. Cooper, K. A., Campos-Gimenez, E., Jimenez Alvarez, D., Nagy, K., Donovan, J. L. & Williamson, G. (2007). Rapid reversed phase ultra-performance liquid chromatography analysis of the major cocoa polyphenols and inter-relationships of their concentrations in chocolate. *Journal of Agricultural and Food Chemistry, 55*(8), 2841-2847.

10. Rimbach, G., Melchin, M., Moehring, J. & Wagner, A. E. (2009). Polyphenols from cocoa and vascular health-A critical review. *International Journal of Molecular Sciences, 10*(10), 4290-4309.

11. Rusconi, M. & Conti, A. (2010). Theobroma cacao L., the Food of the Gods: a scientific approach beyond myths and claims. *Pharmacological Research, 61*(1), 5-13.

12. Langer, R., Leitus, G., Ben-David, Y. & Milstein, D. (2011). Efficient hydrogenation of ketones catalyzed by an iron pincer complex. *Angewandte Chemie., 50*(9), 2168-2172.

13. Gottumukkala, R. V., Nadimpalli, N., Sukala, K. & Subbaraju, G. V. (2014). Determination of Catechin and Epicatechin content in chocolates by high-performance liquid chromatography. *International Scholarly Research Notices.*

14. Hii, C. L., Law, C. L., Suzannah, S. & Cloke, M. (2009). Polyphenols in cocoa (*Theobroma cacao L.*). *Asian Journal of Food and Agro-Industry, 2*(4), 702-722.

15. Kumar, S. & Prasad, K. (2017). Optimization of Flaked Rice Dry Roasting in Common Salt and Studies on Associated Changes in Chemical, Nutritional, Optical, Physical, Rheological and Textural Attributes. *Asian Journal of Chemistry, 29*(6), 1380.

16. Stojceska, V., Ainsworth, P., Plunkett, A., İbanoğlu, E. & İbanoğlu, Ş. (2008). Cauliflower by-products as a new source of dietary fibre, antioxidants and proteins in cereal based ready-to-eat expanded snacks. *Journal of Food Engineering, 87*(4), 554-563.

17. Kumar, S., Haq, R. U. & Prasad, K. (2016). Studies on physico-chemical, functional, pasting and morphological characteristics of developed extra thin flaked rice. *Journal of the Saudi Society of Agricultural Sciences.*

18. AOAC, Official Methods of Analysis. (2012). 19th Edn, 976.05.

19. Sadasivam, S. (2005). *Biochemical methods*. (2nd Ed.). New Age International.

20. Deepa, G., Singh, V. & Naidu, K. A. (2008). Nutrient composition and physicochemical properties of Indian medicinal rice–Njavara. *Food Chemistry, 106*(1), 165-171.