JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

BLACK & GOLD FUSION: DEVELOPMENT AND QUALITY EVALUATION OF BLACK RICE (*ORYZA SATIVA* L.) AND CORN INTEGRATED BREAKFAST CEREAL FLAKES

[1]Anjali Ahire, [2]Shalini Yadav
[1]Master's Student, [2]Assistant Professor,
[1]Department of Food Technology,
[1]Parul University, Vadodara, Gujarat

Abstract: The study of nutrition based breakfast cereal flakes development was carried out at the department of food technology, Parul Institute of Applied Sciences, Parul University, Vadodara, Gujarat. The main purpose of study was to develop a sugar free based breakfast cereal flakes provide nutritious qualities and helpful to pregnant and lactating women also. The breakfast cereal flakes with combination of black rice and corn was developed using the date syrup, black rice and corn. Overall product was analyzed. The physiochemical analysis like moisture, ash, protein, fat and carbohydrate were analyzed. The micronutrients like calcium, iron, vitamin E were analyzed and compared with the simple corn flake's Proximate and micronutrient values. The mineral composition of breakfast cereal flakes was high in calcium, iron. As well as Increase in the Protein content. The micronutrient values and one macronutrient value of breakfast cereal flakes were compared with the standard values of RDA (NIN) of moderately active men, moderately active women and pregnant women as per the % of Daily value (DV).

Keywords: Black rice, corn, Breakfast cereals, Proximate analysis, Antioxidant analysis, Recommended dietary allowance (RDA).

1. INTRODUCTION

Corn is an important food grain and it was introduced to Europe, China, and the rest of the world over the next 100 years. [1] It is available in tropical and warm region. Corn is used as a staple food in many parts of the world, is also widely used as animal feed, and has recently gained importance as an industrial raw material for producing biofuels, chemical compounds, pseudo plastics, and other materials.is increasing.

Corn-starch is nearly 100% digestible, and its digestibility can be increased by processing the grain. [2] Its production climbed by more than 12 times, from a low 1.73 million tons to 21.73 million tons. It now has a mean yield of 2.54 tons/hectare across 8.55 million hectares. [3] Corn is most commonly used as corn flour, corn starch, or corn flakes. Corn is rich in calcium and protein and It is mainly found in popcorn, corn chat, corn flour etc. The resistant starch in corn is help to reduce type 2 diabetes [1]. Rice is the main staple food and major cereal crop. O. sativa the most widely grown of the two cultivated species. [4] China has the most black rice resources (62 %), followed by Sri Lanka (8.6 percent), Indonesia (7.2%), India (5.1%), Bangladesh (4.1%), and a small number of countries in Malaysia. [5]

It has the most antioxidants per serving. Rice *(Oryza sativa L.*) pigmented variety, like black rice, have a higher substance of phenolic compounds when contrasted with other rice varieties. Anthocyanin, a key pigment, may stop the progression of plaques in the arteries, which are the primary cause of most heart attacks [6]. Black rice is considered as a nutraceutical. It gives numerous medical benefits including anticipation and therapy of infections. [7]

Over 90%, breakfast cereals are a significant and well-established food category. Consumers are well aware of the benefits of having a regular, nutritious breakfast, including improved memory, balanced insulin and cholesterol levels, increased physical activity, and a lower risk of obesity.
Several Indian customers chose morning cereals as a result of urbanization, changing lifestyles, and a growth in inclination for healthy eating. For the past few years, the practice of skipping breakfast has decreased while worldwide breakfast consumption per capita has increased. [8]

Date syrup also contains protein, metallic acids, and minerals. In addition, dates syrup contains major carbohydrates (86.6%), some of which have been reduced sugars (81.7%) along with sucrose (4.9%).[9] The study presents the developments of breakfast cereal flakes with the major ingredients are black rice, corn and date syrup. The simplest ready-to-eat food accessible to buyers is flaked cereal grains. A typical flake cereal may contain 90% cereal ingredients plus 8% sugar, 1% malt, and 1% salt in its finished product. [10]

1.1 Objectives:

1. To analyse proximate values of breakfast cereal flakes.
2. To analyse the micronutrient values of breakfast cereal flakes.
3. To estimate the Antioxidant of developed product by DPPH Assay.
4. To study the comparison with RDA standard value of moderately active men/women and pregnant women.

2. MATERIAL AND METHODS

2.1 Material:

The raw material Black rice, Corn, Date palm fruit, salt, baking paper was purchased from local market of Vadodara city, (Gujarat).

2.2 Chemicals and Glassware:

Sufficient glassware and chemicals for analytical grade are available in the Food Analysis and Food Processing lab, Department of food technology, Parul institute of applied sciences, Parul University, Vadodara.

2.3 Method:

The various ingredients used for the standardization of recipe for the preparation breakfast cereal flakes consists of Black rice (70%), Corn (30 %), Date syrup (30 %), Salt was added for preservative and taste purpose.

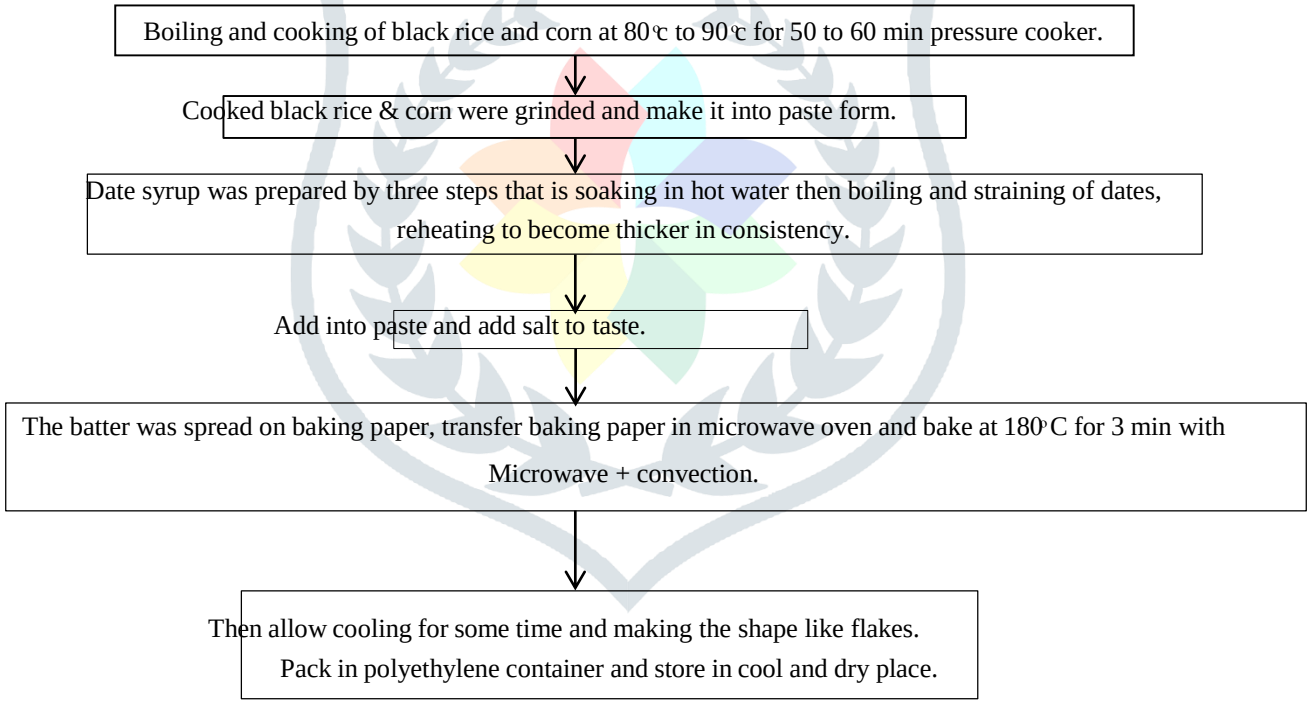

Fig.1. flowchart for preparation of breakfast cereal flakes

Fig.2. breakfast cereal flakes

Table.1. formulation of breakfast cereal flakes

Constituents	S0	S1	S2
Black rice	-	50%	70%
Corn	100g	50%	30%
Date syrup	-	30%	30%

3. RESULT AND DISCUSSION:

3.1. PROXIMATE ANALYSIS OF THE PRODUCT:

3.1.1 Determination of Moisture Content:

Determine moisture content using FSSAI Manual (2016). [11] Weigh 5g sample in a tared dish, dry in oven at 130-133°C for 2 hours. Cool in desiccator, weigh for final result.

3.1.2 Determination of Ash Content:

A sample taken which was left over after the determination of moisture assessment in an empty dish and ignite it.Transfer to a muffle furnace at 550-600 ◦ C and ignite till gray ash is formed. Cool in the dessicator and weigh. Repeat heating, cooling, and weighing until difference <1 mg. Record lowest weight. (FSSAI Manual of methods, 2016) [11]

3.1.3 Determination of Protein Content:

Determination of protein by using kjeldhal apparatus. Boil sample with potassium sulphate, sulphuric acid, and mercury. Treat with alkali, liberate ammonia, and titrate excess acid with 0.1 N sodium hydroxide. (IS 7219:1973). [12]

3.1.4 Determination of Fat Content:

The total fat was determined by using Soxhlet apparatus. Accurately weigh 10-30g sample, place in Soxhlet apparatus, extract for 16 hours, dry, and weigh at 30-minute intervals until mass loss between consecutive weighings is <2 mg. Record lowest mass. (IS 12711:1989). [13]

3.1.5 Determination of Carbohydrate Content:

After assessing moisture, ash, protein, and fat content. It was determined by subtracting from 100 the sum of the values moisture, protein, fat, ash. (IS 1656:2022). [14]

4.1. MICRONUTRIENT ANALYSIS OF THE PRODUCT:

4.1.1 Determination of Vitamin E:

Vitamin E was determined by chromatography method and absorption was measured by colorimeter. (IS 7235:1974). [15]

4.1.2 Determination of Iron:

Iron content was determined by Inductively coupled plasma optical emission spectrometer. Method described in (FSSAI Manual-metals, 2016). [16]

4.1.3 Determination of Calcium:

Calcium content was determined by ICP OES. By given method of (FSSAI Manual – metals, 2016). [16]

5. ANTIOXIDANT ANALYSIS BY DPPH ASSAY:

Antioxidants were estimated by using Spectrophotometer with the concentrations of DPPH solution and methanol. The method was developed by Blois (1958). [17]

6. SENSORY EVALUATION OF DEVELOPED PRODUCT:

Breakfast cereal flakes was evaluated for different sensory attributes by ten panelists. Sensory attributes like appearance, taste, texture, odour and over all acceptability for all the samples were assessed using nine-point hedonic scale.

7. RESULT AND DISCUSSION:

7.1 Physiochemical and micronutrient analysis:

Results of physiochemical analysis and micronutrient analysis were compared with Simple corn flakes. Results compare with the work by P. S. Prasanthi.et.al. (2017). [18]

Table 2: Result of Proximate & Micronutrient analysis:

Parameters	Breakfast cereal flakes (S2)	Corn flakes (100g)
Moisture %	14.70	5.83
Ash %	1.90	0.70
Protein %	10.25	7.54
Fat %	3.92	4.58
Carbohydrate %	69.23	77.21
Vit E (mg/g)	2.03	-
Iron (mg/g)	4.47	1.15
Calcium (mg/g)	34.718	1.6

Proximate and micronutrient composition of breakfast cereal flakes & corn flakes are present in table 2. The combination of black rice and corn resulted in a 10.25% increase in protein content. The moisture level of corn flakes was high (14.70%) due to black rice's strong water absorption capacity. The ash concentration (1.90%) had been greater than in ordinary corn flakes. The fat content was significantly lower than corn flakes, with 3.92 %. According to the study, breakfast cereal flakes have a carbohydrate level of approximately 69.23%, but corn flakes have 77.21% carbohydrate since maize has a higher carbohydrate value. On the other hand, micronutrients such as iron (4.47mg/g) and calcium (34.718mg/g) were more prevalent than corn flakes because black rice is rich in iron and corn is rich in calcium. Date syrup additionally contains a greater proportion of calcium, thus there is an increase in calcium content. Vitamin E was in lower amount because occurs only in black rice. It shows the negligible amount in corn flakes.

Table.3: Recommended dietary allowance (RDA) of Various Nutrients (NIN ICMR 2020) [19]

Nutrient component supplied	**Recommended dietary allowance (g/d, mg/d)**			**Daily value (%) S2/100 g**		
	Moderately Active Men	Moderately Active women	Pregnant women	M. Active Men	M. Active Women	Pregnant women
Calcium	1000 mg/d	1000 mg/d	1000 mg/d	3.47	3.47	3.47
Iron	19 mg/d	29.0 mg/d	27 mg/d	23.52	15.41	16.55
Protein	54 mg/d	46.0 g/d	68 g/d	18.98	22.28	15.07

% Daily value (DV) of various nutrients for formulation (S2) are presented in table 3. The calcium content in the breakfast cereal flakes were 34.718 mg/100 g respectively, were fulfilling 3.47% for moderately active man, moderately active women and for pregnant women also. Daily value of calcium is high because it is necessary for pregnant women during pregnancy. The iron content in (S2) were 4.47 mg/100 g, it were fulfilling 23.52% for moderately active man, 15.41% for moderately active women and 16.55% of daily value for pregnant women. Similarly, the protein content in breakfast cereal flakes (S2) were high i.e.10.25%, were fulfilling 18.98% for moderately active man, 22.28% for moderately active women and 15.07% for pregnant women. Therefore overall product was rich in iron and protein. Other Micronutrients like zinc, potassium value may also Increases with increasing calcium and Iron content in overall product.

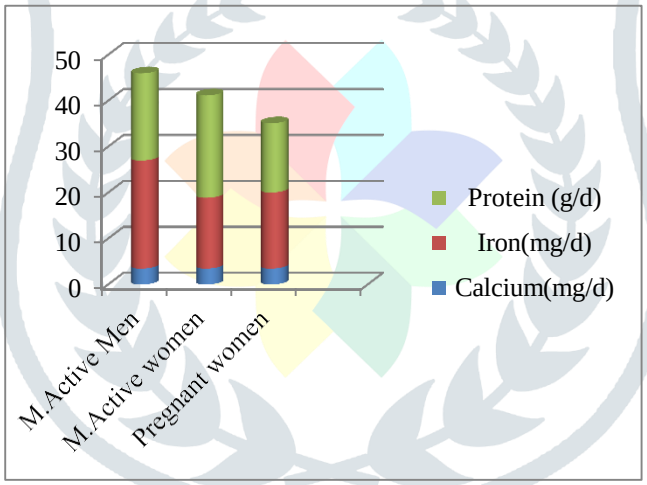

Fig.3: Daily value (DV %) of calcium, Iron and Protein for Moderately Active men/ women and pregnant women.

7.2 Result of Antioxidant Analysis:

Table.4: Absorbance & scavenging effect % of DPPH Assay

Concentration (µg/ml)	Control	Absorbance	Scavenging effect %
100	0.666	0.577	13.36
200	0.666	0.510	23.42
400	0.666	0.411	38.28
600	0.666	0.399	40.09
800	0.666	0.386	42.04
1000	0.666	0.389	41.59

Explanation:

The X-axis represents the concentrations of the tested antioxidant or compound. The Y-axis represents the absorbance of the sample at a specific wavelength, usually measured at around 517 nm. Absorbance is a measure of how much light the sample absorbs at that particular wavelength. As the DPPH radical is reduced by the antioxidant, the absorbance decreases. The graph may have a line indicating the percentage of scavenging effect at each concentration. Free radical scavenging capacity was highest at 800 µg/ml with 42.04 %. This represents the ability of the antioxidant to neutralize the DPPH radical. The higher the percentage, the more effective antioxidant is at scavenging free radicals. As the concentration of the antioxidant increases, the absorbance at 517 nm decreases, reflecting an increase in the scavenging effect. The graph is used to determine the concentration at which the antioxidant exhibits significant scavenging activity and to compare the antioxidant capacities of different concentrations.

7.3 Evaluation of sensory analysis:

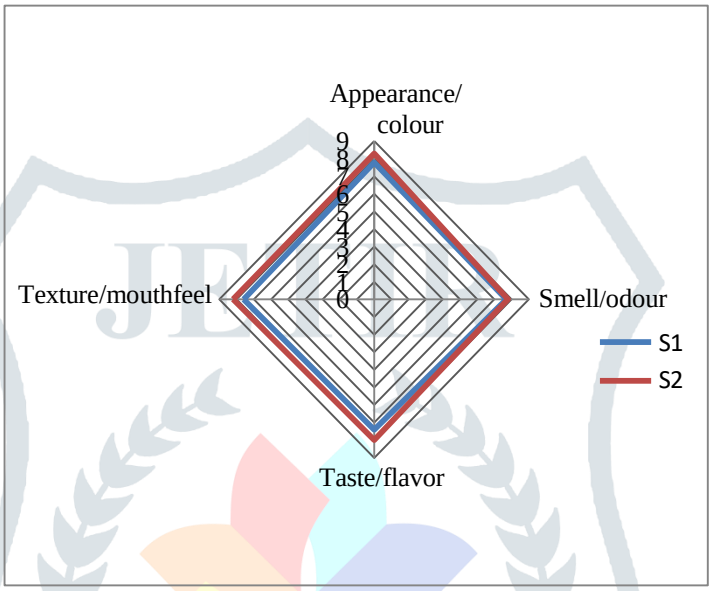

Fig.4: result of sensory evaluation

8. CONCLUSION:

The Study indicates that corn flake containing black rice and date syrup carries the commercial acceptability in the market. The availability of both macro and micro nutrients in the breakfast cereal flakes may be enhanced by black rice. S2 was found to be the best than S1 formulation. Breakfast cereal flakes with S2 formulation contain 14.70% moisture, 1.90% ash, 10.25% protein, 69.23% carbohydrate, 3.92% fat content. It contains 2.03 mg of vitamin E, 4.47 mg/g iron and 3.47 mg/g calcium. Therefore the prepared breakfast cereal flakes can provide enough energy and protein to the body. It provides high amount of Protein, Iron and Calcium which is necessary for adolescent girl and pregnant women. The study reveals that the Recommended Dietary Allowances (RDAs) of various nutrients, as established by the National Institute of Nutrition (NIN) under the Indian Council of Medical Research (ICMR), provide the daily value (%) of essential nutrients to meet the daily requirements of moderately active men and women, as well as pregnant women. People who suffering from diabetes can consume this sugar free breakfast cereal flakes. Breakfast cereal flakes can be the healthy alternative to the unhealthy flakes on the market.

9. ACKNOWLEDGEMENT:

I would like to acknowledge the invaluable guidance and mentorship provided by Asst. prof. Shalini Yadav, Head of dept. PIAS, Parul University, whose insights and encouragement played a pivotal role in shaping the direction of this research endeavor. I extend the heartfelt gratitude to the participants who volunteered their time and feedback during the sensory evaluation sessions. I am grateful to the Food Technology Department at PIAS for granting me access to their food technology laboratory and providing all the necessary instruments for conducting various analyses.

10. REFERENCES:

[1] Siyuan Sheng, Tong Li et.al. (2018), Corn phytochemicals and their health benefits, Food Science and Human Wellness Volume 7, Issue 3.

[2] Silverio Garcia-Lara (2019), corn history and culture Corn (Third Edition) Chemistry and Technology Pages 1-18. (https://doi.org/10.1016/B978-0-12-811971-6.00001-2).
[3] Kumar, Ramanujam & Kumar, Bhupender & Kaul, Jyoti & Karjagi, Chikkappa & Jat, Shankar & Parihar, C.M. & Kumar, Ashok. (2012). Maize research in India -historical prospective and future challenges. Maize Journal. 1. 1-6.
[4] Black Rice: Research, History and Development, U.K.S Kushwaha Springer, 19 Feb 2016 page no. 21-25.
[5] Dr. Hemraj Meena1, Dharmendra Kumar2 , Harsh Wardhan Dhakad3, Assistant, Professor1,3, Research Scholar2 , School of Agriculture Science & Technology, Sangam University, Bhilwara Rajasthan, ARTICLE ID: 012 vol.1 Issue-8, APRIL (2021).
[6] International Journal of Health Sciences & Research (www.ijhsr.org) 241 Vol.8; Issue: 2; February (2018), pg. 241,242.
[7] Maitrayee Das, Uma Dash, et.al. Black rice: A comprehensive review on its bioactive compounds, potential health benefits and food applications, Food Chemistry Advances, Volume 3, (2023).
[8] Simi Simon, A Study On The Determinants Of Consumer Buying Behavior Towards Ready To Eat Breakfast Cereals (2018).
[9] Hilfi, Mohammad & Al-fekaiki, Dhia & Al-Hilphy, Asaad. (2019). Identification and Determination of Metal Elements of Dates Syrup Extracted from Various Varieties Using SEM-EDS Technique. Basrah Journal of Agricultural Sciences. 32. 126-134.
[10] Tribelhom, R. E. Marcel Dekker, Inc. 1991, Breakfast Cereals, Handbook of Cereal Science and Technology
[11] FSSAI Manual of methods (cereal and cereal products, (2016).
[12] Indian standard analysis (IS 7219: 1973) method for Protein content.
[13] Indian standard analysis method (IS 12711:1989) for fat content.
[14] Indian standard analysis method (IS 1656: 2022) for Carbohydrate.
[15] Indian standard analysis method (IS: 7235 – 1974) for Vitamin E.
[16] FSSAI (Manual of methods - metals, 2016) for analysis of Iron and calcium.
[17] Blois, M.S. (1958) Antioxidant Determinations by the Use of a Stable Free Radical. Nature, 181, 1199- 1200. http://dx.doi.org/10.1038/1811199a0
[18] Prasanthi, P.S., Naveena, N., Vishnuvardhana Rao, M. *et al.* Compositional variability of nutrients and phytochemicals in corn after processing. *J Food Sci Technol* 54, 1080–1090 (2017).
[19] ICMR – NIN Expert Group on Nutrient Requirement for Indians, Dietary Allowances (RDA) 2020.