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Studies on Nutritient Composition of Extruded and Flaked Rice Developed from Selected Bold Rice Varieties

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ABSTRACT

Rice is a cereal grain which plays an important dietary role in nutrition of human beings. It is a good source of calories, protein, carbohydrates and vitamins. The present study was undertaken to know the nutrient composition of extruded and flaked rice varieties grown in RARS, Maruteru, West Godavari district, Andhra Pradesh. The extrusion process resulted in increase in protein, fat, calcium and iron in both varieties MTU 3626 and MTU 1001 which is mainly attributed to the addition of corn grits in the extrusion. The flaking process resulted in increase in protein, fat, fiber, calcium and iron in both varieties MTU 3626 and MTU 1001. Both the rice varieties tested are suitable for preparation of convenience and ready to eat snacks, that are nutritious and can serve as good source of food to fulfill the nutritional needs of individuals of all age groups.

Key words: *Extruded rice, Flaked rice, Nutrient Composition*

Paddy (Oryza sativa L.) is important cereal crop in world next to wheat with the world production of 741.47 MMT. India had contributed about one fifth of its total world production in the year 2014-2015 from crop area of 43.40 million hectare (FAOSTAT, 2017). Asian countries have contributed about 90% in the world for paddy production. (Kumar and Prasad, 2017). Rice has approximately 7.3% protein, 2.2% fat, 64.3% carbohydrate, 0.8% fiber and 1.4% ash content (Zhoul *et al*., 2002). The bran contains high percent of oil (19-23%) abundant in natural antioxidants, especially γ oryzanol well-known to decrease low-density lipoprotein cholesterol levels and total cholesterol levels in the blood thus lower the danger of heart diseases (Srisaipet and Nuddagul, 2014) . Rice utilizing is decreasing due to altering taste choices, well financial strength and also due to replacing the cost of cereals by various other substitutes. In countries like Japan, China and United States a variety of rice based products like pre cooked, convenience products, extruded products, noodles, canned products and traditional products are used. (Toriyama *et al*. 2005). About 14.46 million tones (10% of the production) is utilized for the manufacturing of rice dependent food stuffs in the country (Chitra *et al*. 2010).

Extrusion cooking is a high-temperature, short-time process in which moistened, expansive, starchy or proteinacious food materials are plasticized and cooked in a tube by combination of moisture, pressure, temperature and mechanical shear, resulting in molecular transformation and chemical reactions (Havck and Huber, 1989 and Castells *et al.*, 2005). Generally, extruded rice products are soft touch , stick together, and loose its nature after cooking. (Wang *et al.* 2013, Charutigan *et al.*2008).

During the extrusion-cooking raw materials are treated by high temperatures and mechanical shearing at relatively low moisture content (Camire et al., 1990). This technique has many advantages, mainly low degradation of food nutrients, and improvement of digestibility by protein denaturation, starch gelatinization, and by preventing the action of antinutritional factors (Alonso *et al*., 2000; Shimelis and Rakshit, 2007).

Rice Flakes are an old traditional food products which can be taken along with or without the adding up of milk or curd as a breakfast food or as a snack item after replacing various processing methods (Kumar and Prasad, 2013).

Avalakki, poha, atukulu and chirwa are the other names of flaked rice developed from pre- roasted paddy which can be used as convenient food. It is used as breakfast cereals, snacks, sweet, savoury and baby foods (Kumar and Prasad, 2013). Polished and white rice contains lesser amount of nutrients when compared to flaked rice. It is flexible and rich nutritional food product as it contains carbohydrates, protein, vitamin and minerals (Bhattacharya, 2011). It also contains greater amounts of dietary fiber, photochemical and minerals. (Maisont and Narkrugsa, 2009).

In the procedure of flaking and roasting starch gets retrograded, damaged and gelatinized to some level to the formation of 'resistant starch' which has greater nutritional importance and plays an important

key role during digestion and absorption in the small intestine due to its roughage, bulk nature of dietary fiber. This changed portion is nutritionally important and acts as dietary fiber creating bulk and roughage, and escapes unaffected during digestion and absorption in the small intestine. In India about one fifth of the rice produced is converted into flakes. (Narasimha H.V 1995) Over 85% of the flaked rice were produced in the traditional tiny-scale production units in India. (Shinde and Durgadevi 2017).

MATERIAL AND METHODS

Sample preparation

Two rice varieties namely MTU 3626 and MTU 1001 were procured and dehulling were done at RARS, Maruteru, West Godavari District. The combination of rice and corn were in the ratio 30 : 70 were mixed using a mixer.

Extrusion cooking

The corn-rice mixtures were processed using a single screw extruder of 10 kg capacity available at College of Home Science, Lam, and Guntur. The Single-screw extruders contain a single rotating screw in a metal barrel. Single-screws consist of three Zones (1) Feeding Zone (2) transition or Compression Zone and (3) metering Zone. The temperature range at which the extrusion-cooking process took place was maintained as 125/130/135°C respectively, in three sections of the extruder. The prepared corn rice mixture was fed in a grainy form in the hopper in the feed section. The screw rotating at 80, 100 and 120 rotations per minute (rpm) pushes the material into the transition section where the screw channel becomes shallow and the material is compacted. A key portion of mechanical energy is degenerated in the section, which resulted in rise in temperature of the material. The material becomes solid as the starch gets gelatinized. Next It enters into the metering zone and conveyed through the die orifice of 4mm wide and circular in shape. The single screw extruders generally have axial or helical grooves on the inner surfaces. This helps to convey and mix the material more effectively. Later the product obtained were conveyed into roaster unit for 1-2 min for attaining crispness in extrudate and finally coated with spice mix in mixer if necessary.

Process of flaking

Paddy were procured from RARS, Maruteru, West Godavari district.The raw paddy was soaked in the water for 48 hours for increasing the moisture content then drained off water completely. The soaked paddy conveyed to paddy roaster. The soaked paddy was roasted at temperature of 175±5°C for 10s immediately placed in the rice flaking machine. The dried husk and bran get crushed and pass through the sieve during flaking process. The obtained flaked rice is cleaned in the flaked rice cleaning machine to separate whole and broken flaked rice. The cleaned flaked rice was further passed through rollers to get fine and extra fine flaked rice product.

Proximate Analusis

Proximate analysis were analyzed by using AACC (2000) and AOAC (2006)

Statistical analysis

The statistical significance was tested by using t-test on mean data separately for each nutrient in order to test the significant difference between the two varieties at $p<0.05$ level. The statistical analysis was done using SPSS software.

RESULTS AND DISCUSSION

The two varieties of rice were subjected to proximate composition of extruded and flaked rice and the data pertaining to the present research of extruded rice is represented in Table 1 and pertaining to flaked rice are tabulated in Table 2.

Proximate and mineral composition of extruded rice varieties MTU 3626 and MTU 1001 respectively were as follows. The moisture (%) was 4.8 and 5.56. Yoo *et al*. (2013) studied the combinations of corn/wheat, sorghum/wheat, and rice and reported that moisture contents of the raw blends were 10.6, 10.0, and 9.2%, respectively for extruded grains moisture contents before drying were 27.0, 29.3, and 25.7, and after drying were 9.3, 7.7, and 9.7%, respectively. Protein (g/100g) was 8.6 and 10.6. Rehal *et al.* (2017) conducted a survey on extruded products in market for various brands and reported that protein content in extruded products ranged from 2.8 – 9.2 g/ 100g. Ash (g/100g) was 1.38 and 2.03. Kthatijah *et al.* (1997) reported a study on fourteen commercially available extruded rice snacks existing in market and revealed that ash content in extruded products ranged from 2.0 – 3.6 (g/100g).Fat (g/100g) was 0.66 and 0.75. Brennan *et al.* (2012) conducted a study on Ready to Eat (RTE) extruded products existing in the market and stated that Fat values ranged from 0.6 – 34.2(g/100g).Fiber (mg/100g) was 2.73 and 2.93, carbohydrates (g/100g) was 86.0 and 79.8 , energy (kcal/100g) was 383 and 3678, calcium (mg/100g) was 11.37 and 12.33 and iron (mg/100g) was 1.83 and 1.26. Results of estimation of nutritive values of extruded rice showed that the process of extrusion has resulted in significant increase in protein, ash, fat content and decrease in energy content of rice when compared to the amounts in raw rice. The increased nutritive value

Table 1. Proximate and mineral composition of extruded rice varieties (per 100 g)

Proximates	MTU 3626	MTU 1001	GM	SD	t- calculated value
Moisture (%)	4.80	5.56	5.15	0.53	1.26
Protein (g)	8.60	10.60	9.60	1.40	2.42
Ash(g)	1.38	2.03	1.70	0.45	1.51
Fat(g)	0.66	0.75	0.70	0.06	0.90
Fiber(g)	2.73	2.93	2.84	0.16	0.54
Carbohydrates (g)	86.00	79.80	82.94	4.32	3.84
Energy (kcal)	383.02	368.57	375.79	10.20	4.40
Calcium (mg)	11.30	12.33	11.85	0.67	2.16
Iron (mg)	1.38	1.26	1.79	0.26	0.38

Table 2. Nutrient composition of flaked rice varieties (per 100 g)

Proximates	MTU 3626	MTU 1001	GM	SD	t-calculated value
Moisture (%)	4.39	6.42	5.40	1.43	4.30
Protein (g)	3.92	4.95	4.43	0.72	3.70
Ash(g)	2.90	3.50	3.20	0.42	2.27
Fat(g)	0.23	0.34	0.28	0.07	0.59
Fiber(g)	3.90	4.59	4.24	0.48	3.70
Carbohydrates (g)	86.53	81.93	84.20	3.25	3.41
Energy (kcal)	365.00	355.00	360.00	6.71	4.40
Calcium (mg)	50.00	55.00	52.50	3.21	4.40
Iron (mg)	0.76	1.45	1.10	0.48	3.64

was because of the addition of 70% of corn with rice in the preparation of extrusion rings.

Significant difference existed among rice varieties after extrusion in terms of carbohydrate and energy. Carbohydrate and energy content were more in MTU 1001 when compared to MTU 3626.

Nutritive values of flaked rice varieties MTU 3626 and MTU 1001 respectively were as follows. The moisture (%) was 4.39 and 6.42. Kumar *et al.* (2017) conducted a study on flaked rice with jaggery, dark chocolate and cocoa powder as coating materials to determine moisture content and reported that roasted flaked rice had 6.20 (%) moisture , Chocolate coated flaked rice had 6.20 (%) moisture and Cocoa coated rice flakes had 5.74(%) moisture. Protein (g/100g) was 3.92 and 4.95. Shiv kumar and kamalesh (2017) studied Gurjari paddy produced flaked rice from Gurjari paddy and compared chemical composition of flaked rice and roasted flaked rice and reported that protein content of flaked rice had 6.06 and roasted flaked rice had 6.02 (g/100g). Ash (g/100g) was 2.90 and 3.50 fat (g/100g) was 0.23 and 0.34 (g/100g). Rahul *et al.* (2019) conducted a study on three rice varieties on proximate, chemical and functional properties of paddy to evaluate suitability to produce flaked rice and reported that Zinc rice, Dokra-Dhokri and mahamaya had fat contents of 3.62, 3.37 and 3.35 respectively. Fiber (mg/100g) 3.90 and 4.59 , carbohydrates (g/100g) was 87 and 82 , energy (kcal/100g) was 365 and 355 , calcium (mg/100g) was 50 and 55 and iron (mg/100g) was 0.76 and 1.45. Shiv kumar and kamalesh (2018) conducted a study on process of soaking and roasting of paddy followed by flaking process and reported that tron content of brown rice had 1.33 roasted rice had 1.60 and flaked rice had 1.67 (g/100g).

Results of estimation of nutritive values of Flaked rice showed that the transformation of rice into flaked rice resulted in significant increase in moisture, protein, fat, fiber, ash, carbohydrates, energy, calcium, and iron. Significant difference existed among rice varieties after transformed into flaked rice in terms of moisture, protein, fiber, carbohydrates, energy, calcium and iron. Moisture, protein, fiber, calcium and iron

were more in MTU 1001 when compared to MTU 3626, whereas carbohydrates and energy were more in MTU 3626 when compared to MTU 1001.

CONCLUSION

From the present study, it can be concluded that value added products can be developed from two rice varieties using extrusion and flaking technologies which can improve nutritional quality of products and add variety in the diet. The extruded products can replace the convenience foods of low nutritional value. Based on the present investigation MTU 1001 rice variety had more nutritient composition in terms of protein, fat, fiber and calcium than MTU 3626 variety. For developing of flaked rice it has been essential that the flaked rice show higher or superior quality in some quality parameter like fat content, fibre content, protein content. Transformation of rice into flaked rice resulted in increase in fiber, iron and protein contents. MTU 1001 variety had more protein, fat, fiber , calcium and iron when compared to MTU 3626 variety.

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