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Nutritional evaluation of Kodo millet and puffed Kodo

Anamika Patel, Pratibha Parihar and Ketki Dhumketi

Abstract
Puffing of cereals is an old traditional food processing method used for preparation of expanded cereal and grain legumes to prepare snack, breakfast or ready-to-eat products. The present investigation was conducted on suitability of kodo millet varieties for puffing. Row kodo millet variety JK48 and JK155 content moisture 7.35 and 7.67, protein 7.92 and 7.94, fat 1.44 and 1.43, carbohydrate 69.48 and 68.35, ash 3.98 and 3.98, fibre 9.83 and 10.63gm/100gm, energy value 322.56 and 318.03kcal/100gm, calcium 27 and 27 and phosphorus 188 and 188mg/100gm respectively. In puffed kodo variety JK48 and JK155 content moisture 3.35 and 3.36, protein 8.02 and 8.12,fat 1.41 and 1.38, carbohydrate 74.38 and 74.20, ash 3.92 and 3.84, fibre 8.92 and 9.10gm/100gm, energy value 342.56 and 341.7kcal/100gm, calcium 18 and 19 and phosphorus 178 and 175mg/100gm respectively. The nutritional quality such as protein, and carbohydrate had increased whereas crude fibre, fat, total ash content, calcium and phosphorus had decreased in both variety of puffed kodo.

Keywords: Puffed, snack, kodo millet

Introduction
Millets are unique among the cereals because of their richness in calcium, dietary fibre, polyphenols, carbohydrates (70-80%) and protein (9-14%). It is a gluten-free cereal grain, an excellent source for people suffering from celiac disease and also rich in phytochemicals which help to lower cholesterol level and reduced cancer risk due to its phytate content (Shadang and Jaganathan, 2014) [10]. Millets are being used as nutraceuticals as they are rich in antioxidants much higher than the major cereal crops. They are reportedly beneficial in curbing asthma, migraine, blood pressure, diabetic heart disease, atherosclerosis and heart attack. The high fibre content in millets prevents gall stone formation The whole grain consumption has health promoting effects like prevention of insulin resistance, heart disease, diabetes, obesity, breast cancer, childhood asthma and premature death (Balasubramanium, 2013). Kodo millet (*Paspalum scrobiculatum*) is a nutritious grain and a good substitute to rice or wheat. The kodo millet *(Paspalum scrobiculatum)* is also known as cow grass, rice grass, ditch millet, Native Paspalum, or Indian crown grass. Kodo millet is widely distributed in damp habitats across the tropics and subtropics of the world. Kodo millet is grown in area of about 907,800 ha with annual production of about 310,710 tonnes (Yadav *et al.* 2013) [12]. It is very beneficial for postmenopausal women suffering from signs of cardiovascular disease like high blood pressure and high cholesterol levels. Kodo millet has the highest free radical (DPPH) quenching activity followed by sorghum and finger millet (Deshpande *et al*. 2015) [5].
Puffed kodo is a rich source of vitamins, minerals, fibres, protein and highly energetic low cost snacks consumed by urban and rural people as like ready to eat breakfast. Kodo puffing is easy and low cost method and better way to avail this high nutritious ready to eat light and healthy food for people. There is need to explore the opportunities towards development of diversified foods for household consumption to achieve nutrition security on sustainable basis (Manoharan and Helen 2016) [7].Therefore the present investigation was conducted to develop ready to eat breakfast from kodo varieties.

Materials and Methods
Experimental material
Kodo millet (*Paspalum scrobiculatum*) varieties JK 155 and JK 48 were procured from Regional Agricultural Research Station, All India Coordinated Research Project on Small Millets, Collage of Agriculture, Rewa (M.P.).

Puffing of kodo millet

Cleaning

Firstly the varieties of kodo millet were cleaned to remove the dirt, dust and foreign matter by winnowing and sieving then graded it according to the different size and shape to remove the small and unhealthy seeds. Healthy, bold and similar sized grains were dried in the sun for 5-6 hours.

Conditioning

Conditioning of kodo millet varieties were done prior to puffing by traditional method in simple (drinking) water for 24 hrs for maintaining the moisture content 19% and conditioned for 15-20 min at room temperature.

Puffing

After conditioning the grains were puffed by Traditional method in open earthen pan. Tempered kodo millets were put in a hot earthen pan at temperature 230°C for 3 minand stirred continuously till the end of puffing sound of the grains. Puffed grains were then removed from hot pan and cool them and the quality parameters were used to assess the puffing qualities (Malleshi and Desikachar 1981) [6].

Packaging

The cooled puffed kodo were packed in two different packaging materials i.e. LDPE bags and polypropylene bags. The sample size was kept constant (100gm) in each packaging materials for storage.

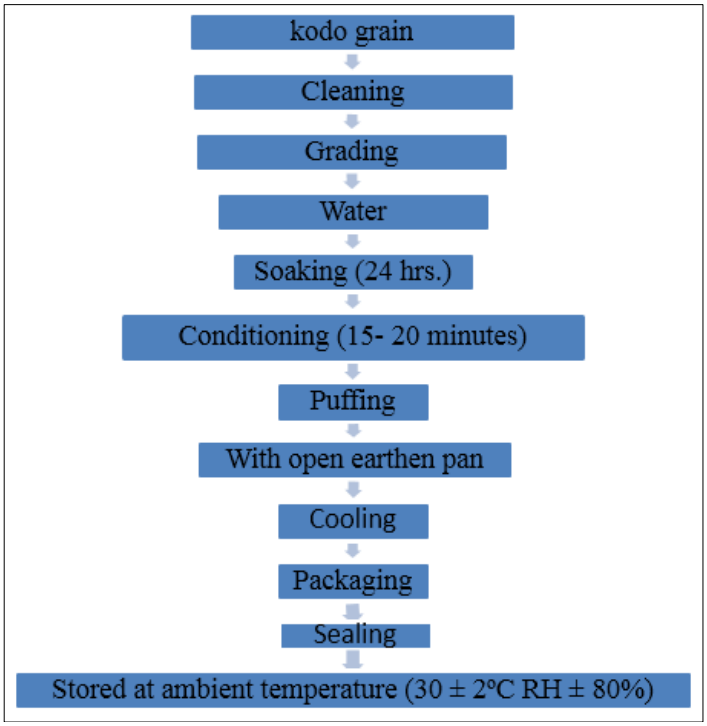
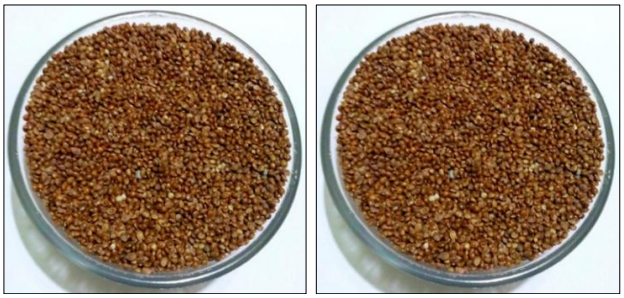
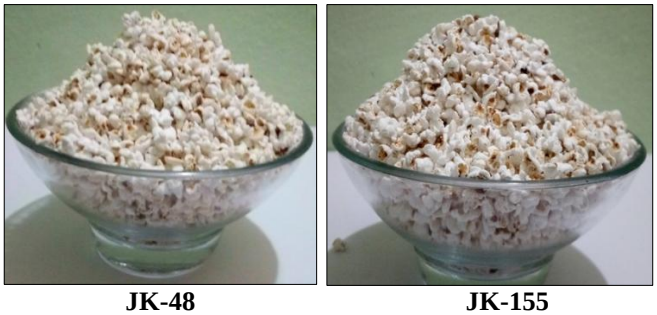


Fig 1: Flow chart for preparation of puffed kodo



JK-48 **JK-155**

Fig 2: Raw Kodo varieties



JK-48 **JK-155**

Fig 3: Puffed kodo viz, traditional method

Quality attributes of puffed kodo millet

The proximate composition (moisture, protein, fat, carbohydrate, ash and fibre) of the puffed kodo millet was determined according to the method A.O.A.C. (1992) [1] using moisture content by moisture meter, protein by conventional Micro-Kjeldhal digestion and distillation procedure using Pelican's Kel Plus digestion and distillation assembly, fat by Soxplus automatic fat analysis system, ash content byMuffle furnace and crude fibre estimate byautomatic fibre analysis system (Make-Pelican). Calcium and phosphorous was determined according to the method Bhargava and Raghupati (1984) [3] using flame photometer and spectrophotometer respectively.The total energy value (Kcal) was calculated by using the Atwater factor method [(9 x fat) + (4 x carbohydrate) + (4 x protein)] as described by Nwabueze (2007) [8].

Results and Discussion

Row kodo millet variety JK48 and JK155 per 100gm content moisture 7.35 and 7.67, protein 7.92 and 7.94, fat 1.44 and 1.43, carbohydrate 69.48 and 68.35, ash 3.98 and 3.98 and fibre 9.83 and 10.63gm, energy value 322.56 and 318.03kcal/100gm, calcium 27 and 27 and phosphorus 188 and 188mg respectively. In puffed kodo variety JK48 and

JK155 per 100gm content moisture 3.35 and 3.36, protein 8.02 and 8.12,fat 1.41 and 1.38, carbohydrate 74.38 and 74.20, ash 3.92 and 3.84 and fibre 8.92 and 9.10gm, energy value 342.56 and 341.7kcal/100gm, calcium 18 and 19 and phosphorus 178 and 175mg respectively. The nutritional quality such as protein, increased after puffing due to hydrolysis of protein to low molecular weight protein and increase in enzymatic activity. Similar trend was reported by Vinita Sharma (2014) [11] in puffing of sorghum, and carbohydrate increased due to puffed grains were concentrated more with endosperm which contributes starch to the kernel. Similar finding was noted by Chaturvedi and Shrivastava *et al.* (2008) [4] in popping of amber and dark genotype of finger millet; whereas moisture, crude fibre, fat, total ash, calcium and phosphorus content had decreased and similar trend was found by Madhu samitasahoo (2013) in popped finger millet varieties. JK48 is more nutritious than the JK155 on the basis of nutritional evaluation.

Table 1: Quality attributes of kodo grain varities and puffed kodo

S. No.	Varieties		Moisture %	Protein %	Fat %	Carbo Hydrate%	Ash %	Fibre %	Energy value (kcal/100gm)
1.	JK-48	Raw grain	7.35	7.92	1.44	69.48	3.98	9.83	322.56
		Puffed kodo	3.35	8.02	1.41	74.38	3.92	8.92	342.56
2.	JK-155	Raw grain	7.67	7.94	1.43	68.35	3.98	10.63	318.03
		Puffed kodo	3.36	8.12	1.38	74.20	3.84	9.10	341.7
CD at 5%			1.604	0.707	N/S	1.659	N/S	N/A	0.047

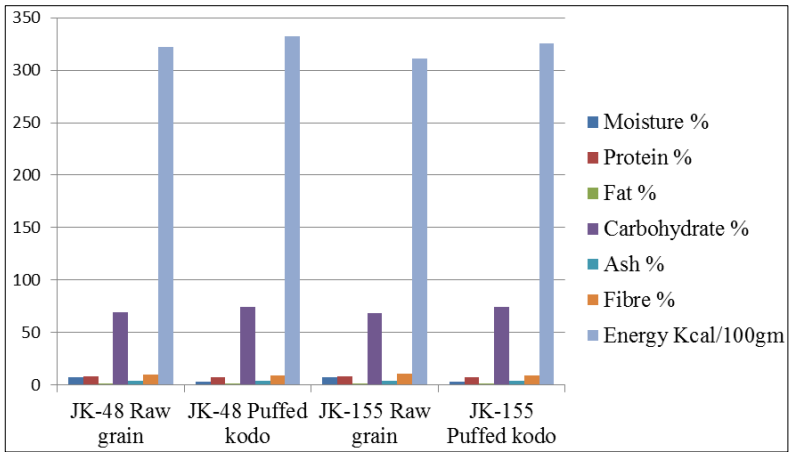


Fig 4: Quality attributes of kodo grain varities and puffed kodo

Table 2: Mineral matter content of raw and puffed kodo varieties

S.no.	Varieties		Calcium (mg/100gm)	Phosphorus (mg/100gm)
1.	JK-48	Raw grain	27	188
		Puffed kodo	18	178
2.	JK-155	Raw grain	27	188
		Puffed kodo	19	175
CD at 5%			1.325	2.208

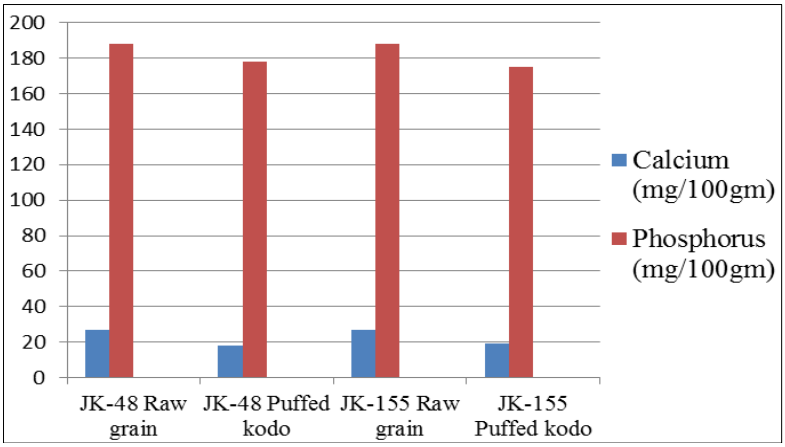


Fig 5: Mineral matter content of raw and puffed kodo varieties

Conclusion

On the basis of findings it was concluded that puffed kodo could be consider the best from nutritional point of view. Hence it was concluded that low cost easily available highly nutritious puffed snacks could be prepared for poor urban peoples. Efforts should also be made for transfer of technique to household women for cottage level. It is therefore, recommended that inclusion of such snack in supplementary feeding programme like ICDS would certainly help in improving the nutritional status of children.

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