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Development and Acceptability of Novel Food Products from Millets for School Children

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A B S T R A C T

Millet based products are economically viable and highlight the excellent medicinal and nutritional qualities. Kodo and kutki based products were developed using various processing variables to enhance the nutritional value, palatability and functionality for school going children of Jabalpur and Dindori districts of Madhya Pradesh state in India. Various developed products were assessed for their acceptability using nine point hedonic scale. The values of mean score of acceptability of malted kodo and kutki millet were found to be 8.30 and 8.27 assessed by the students and 7.94 and 7.77 by the teachers respectively whereas mean score values of puffed sweet ball of kodo and kutki millet were found to be 8.19 and 8.25 assessed by the students and 8.50 and 8.61 by the teachers respectively from Jabalpur district. In case of Dindori district, mean score values of acceptability of malted kodo and kutki millet were found to be 8.33 and 8.50 assessed by the students and 8.42 and 8.71 by the teachers respectively whereas mean score values for a acceptability of puffed sweet ball of kodo and kutki millet, were recorded as 8.41 and 8.87 by the students respectively and 8.28 and 8.57 assessed by the teachers respectively. The results showed that all the products of kodo and kutki millet were acceptable but malted drink of kodo millet and sweet ball of puffed kutki millet were found to be more acceptable by the students and teachers from Jabalpur district whereas malted drink and sweet ball of puffed kutki millet were found to be more acceptable by teachers and students from Dindori district.

Introduction

Millets are nutritionally rich and occupy an important place in the diet of people. It is considered as crop in adverse agro-climatic conditions (Kumari *et al.*, 2004). Millets are being used as nutraceuticals as they are rich in antioxidants and much higher than the major cereal crops. Millets play very specific role in human nutrition because of their multiple qualities and good source of minerals. Millet are considered highly nutritious, non-glutinous and non-acid forming food and easy to digest and suitable for diabetic patient.

Millets are rich in fibre, B vitamins, especially niacin, B_6 and folic acid, calcium, iron, potassium, magnesium and zinc. Minor millets not only have nutritional value but also tremendous medicinal uses. They are used in the treatment of different diseases like Cancer, Leprosy and Pneumonia etc. (Bachar *et al.*, 2013). They are also 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, ischemic stroke, obesity, breast cancer, childhood asthma and premature death (Balasubramanium, 2013). They are also called as 'nutricereals' because of their important contribution to national food security and potential health benefits in combating various diseases (Chandrasekara and Shahidi, 2012). Puffing or popping 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 either plain or with some spices/salt/sweeteners. Puffing can be accomplished by using dry heat such as sand roasting, roasting using salt, gun puffing, hot oil frying, using heating medium such as hot air or microwave radiation (Jaybhaye *et al.*, 2014).

Traditionally, the millet malt is utilized for infant feeding purpose. Malting process awakens/activates the enzymes, resulting in the conversion of starch to fermentable sugars, partial hydrolysis of proteins and other macromolecules thereby increasing the bioavailability of nutrients. The malting process of millet grains was found to improve the nutritional characteristics of the processed product (Prakash and Chopra, 2016). It has also been reported to increase significantly the nutrient composition, vitamins B, C and improve their availability and sensory attributes (Sangita and Srivastav, 2000). Millet malt is commonly used as a cereal base for low dietary bulk and calorie dense weaning foods. Millet based products are economically viable and also highlight the excellent medicinal and nutritional qualities. In the recent year Government of Madhya Pradesh (M.P.) in India has been playing active role in promoting the cultivation and marketing of millet crop. Millets products are economically low cost and better way to avail this high nutritious ready to eat light and healthy food for growing children. There is a need to explore the opportunities towards development of diversified foods for school going children and create awareness for consumption to achieve nutritional security on sustainable basis (Manoharan and Helen, 2015). Related to improvement of nutritional characteristics, sensory properties and convenience, there are some processing technologies that are used in manufacturing of food products. These include soaking, puffing, fermentation and germination/malting. These procedures aim to increase the physicochemical accessibility of micronutrients, decrease the content of antinutrients such as phytates or increase the content of compounds that improve bioavailability (Hotz and Gibson, 2007). The present investigation was undertaken to develop millet based food products and assess their acceptability by school going children to promote consumption of millet foods during mid day meal (MDM) programme.

Materials and Methods

The present investigation was carried out in the Department of Food Science and Technology, JNKVV, Jabalpur (M.P.). Samples of kodo and kutki millet were procured from Dindori and Jabalpur districts. Different products such as puffed, malt, sweet ball and malted drink were developed from

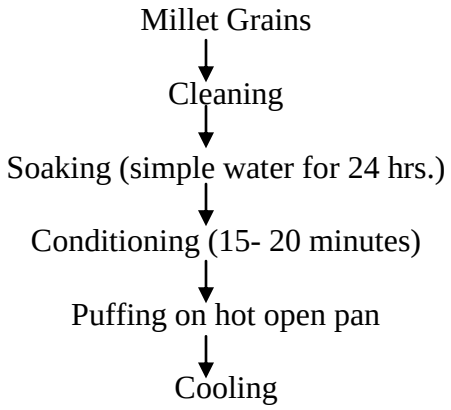
kodo and kutki millet. Four schools were selected from Jabalpur and three schools from Dindori districts. The assessment of acceptability of developed products was done among the teachers and students of the selected schools during MDM programme.

Products development

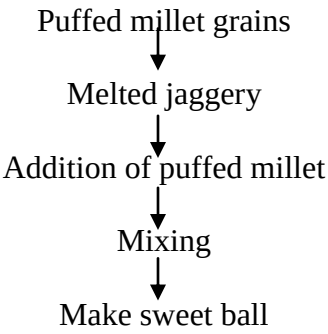
Puffed products

Firstly the millets were cleaned to remove the dirt, dust and foreign matter by winnowing and sieving. Conditioning of millet grains was done prior to puffing by steeping in simple water for 24 hrs for maintaining the moisture content up to 20%. The water was drained and soaked grains conditioned for 15-20 min to achieve at three different levels (16%, 18% and 20%) of moisture. Then tempered grains were put in a hot pan at three different levels of temperature (200°C, 210°C and 220°C) for 3 min. and stirred continuously till the puffing sound of the grains stopped. Puffed grains were then removed from hot pan and cooled in room condition. Puffing was done using traditional method of Patel *et al.,* (2018). Similarly sweet ball was prepared using puffed millets by addition of melted jaggery making into ball shape.

Flow diagram: Method of puffing process



Flow diagram: Method for preparation of sweet ball



Malting of millet

Clean millet seeds were washed with water and steeped in running water for about for different periods ranging from 12, 24 and 36 hrs. The excess water was drained out and seeds were allowed to germinate for different periods ranging from 24, 48 and 72 hrs. Non-

germinated seeds were removed by sieving. The germinated seeds were dried in a hot air oven at 50ºC for 20 hrs. The rootlets were removed by brushing gently. The malted seeds were ground through 80 mesh sieve.

Flow diagram: Method of malting process

Cleaning of millet Grains
↓
Steeping
↓
Germination
↓
Kilning of Sprouts
↓
Roasting
↓
Dehusking / Grinding
↓
Millet malt

Developed products

			
Puffed kodo	**Puffed kutki**	**Malted kodo**	**Malted kutki**
			
Sweet ball of puffed kodo	**Sweet ball of puffed kutki**	**Malted drink of kodo**	**Malted drink of kutki**

Standardization of Products

A number of trials were conducted by taking varying levels of temperature, moisture and steeping time. Accordingly puffed product from millet were prepared using different temperature ranging from 200, 210 and 220^{0}C, moisture ranging from 16, 18 and

20%. Likewise, malted products from millets were prepared by steeping at varied periods ranging from 12, 24 and 36 hrs and germination time ranging from 24, 48 and 72hrs. The developed products were standardized by using nine point hedonic scale and found that in case of puffed millet, kodo grains puffed better at 18% moisture content and temperature of 220^0C whereas kutki grains puffed at 16% moisture content and temperature of 200^0C. Both malted products of kodo and kutki millet were standardized under optimum condition of steeping time at 24 hrs and germination time for 72 hrs and 48 hrs respectively.

Acceptability test of products

Four schools were selected from Jabalpur and three schools from Dindori districts for overall acceptability test by using nine point hedonic scale as described by Amerine *et al.*, (1965).

Results and Discussion

Consumer acceptability of developed products from Jabalpur district

Consumer acceptability score of food products such as sweet ball and malted drink of kodo and kutki millet from Jabalpur district is presented in Table 1. Mean score values of acceptability of malted kodo and kutki millet were found to be 8.30 and 8.27 assessed by the students and 7.94 and 7.77 by the teachers respectively. It was observed that the malted drink of kodo millet was found to be more acceptable by school going students as compared to teachers. In case of sweet ball, mean score values of puffed sweet ball of kodo and kutki millet were found to be 8.19 and 8.25 by the students and 8.50 and 8.61 by the teachers respectively.

Sweet ball of puffed kutki millet was found to be more acceptable by the teachers as compared to the students of Jabalpur district. Sweet ball of kutki millet scored highest mean score value in comparison to malted drink of kodo and kutki millet. Malted drink of millet was more acceptable by the students whereas sweet balls of puffed millets were more acceptable by the teachers.

This might be due to variation in liking and disliking of person. Similar results have also been reported by Parvathi *et al.*, (2015) for sensory evaluation of malted health drink from prepared millets. Bansal and Kour, (2018) concluded that the beverages supplemented with 10 percent level of malted ragi can be successfully developed with high nutritional value and without imposing a negative impact on sensory attributes.

Table.1 Consumer acceptability of developed products from Jabalpur district

	Overall acceptability rating (mean±SD)			
	Kodo millet		**Kutki millet**	
	Malted drink	**Puffed sweet ball**	**Malted drink**	**Puffed Sweet ball**
Students (n=36)	8.30±1	8.19±0.95	8.27±1	8.25±0.93
Teachers (n=18)	7.94±0.80	8.50±0.78	7.77±0.87	8.61±0.60

Maximum value of acceptability rating is 10
n = Number of students and teachers
SD = Standard deviation

Consumer acceptability of developed products from Dindori districts

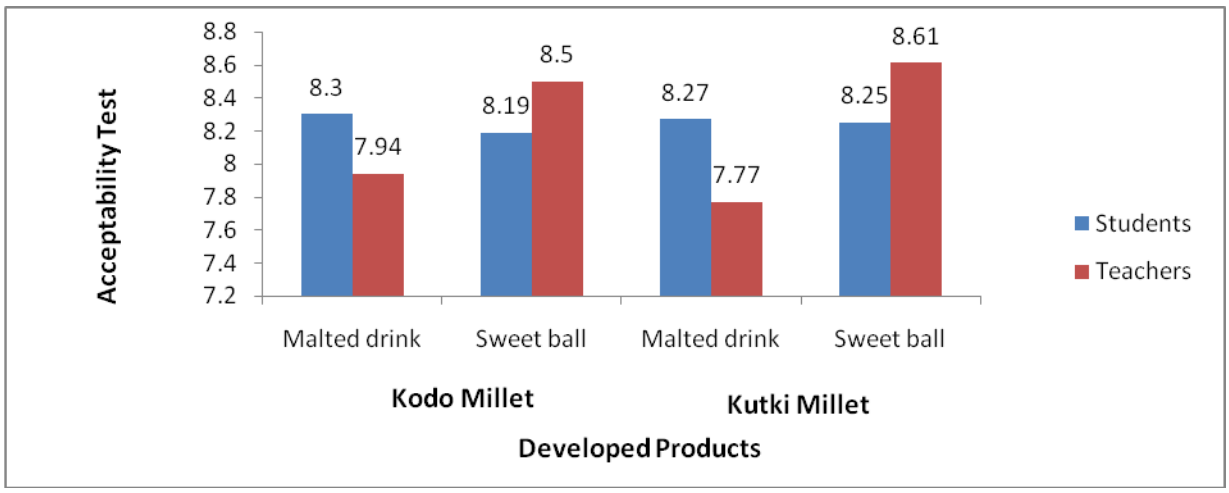


Table.2 Consumer acceptability of developed products from Dindori district

	Overall acceptability rating (mean±SD)			
	Kodo millet		Kutki millet	
	Malted drink	Puffed sweet ball	Malted drink	Puffed sweet ball
Students (n=24)	8.33±0.81	8.41±0.65	8.50±0.72	8.87±0.33
Teachers (n=7)	8.42±0.53	8.28±1.11	8.71±0.48	8.57±0.53

Maximum value of acceptability rating is 10.
n = Number of students and teachers
SD = Standard deviation

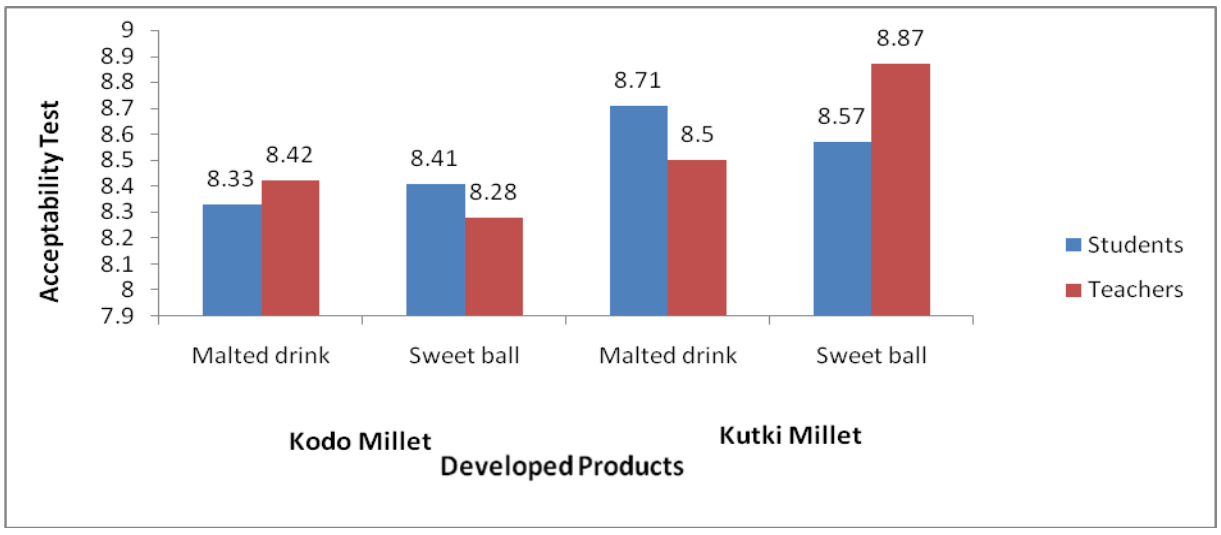


Table 2 showed that the mean score values for acceptability of malted kodo and kutki millet were found to be 8.33 and 8.50 respectively assessed by the students and 8.42 and 8.71 respectively by the teachers. It was also observed that the malted drink of kutki was

more acceptable by school teachers as compared to students. Likewise, mean score values for acceptability of puffed sweet ball of kodo and kutki millet were found to be 8.41 and 8.87 by the students respectively and 8.28 and 8.57 by the teachers respectively. Similar results were also reported by Patel *et al.,* (2018) for puffed kodo millet. It was also seen that sweet ball of puffed kutki millet was more acceptable as compared to puffed sweet ball of kodo millet. Sweet ball of kutki millet recorded highest mean score value in comparison to malted drink of kodo and kutki millet. Sweet ball of puffed millet was more acceptable by the students whereas malted drink of millets were more acceptable by the teachers. Various workers have also reported the acceptability scores of millet based health drinks Mirza *et al.,* (2014) reported that the variation in overall acceptability score of popped finger millet grains of the six genotypes. Nishad *et al.,* (2017) conducted sensory evaluation for the health drink prepared by using the composite flour of minor millets. The drink showed high consumer acceptability by the panelists.

In conclusion, minor millets play an important role in the food and nutritional security of the poor in arid and semiarid regions of the world. Millet products are economically viable and also highlight the excellent medicinal and nutritional qualities. On the basis of findings it was concluded that millets products could be considered the best from nutritional and sensory quality point of view. All products of kodo and kutki millet were acceptable but malted health drink of kodo and sweet ball of puffed kutki millet were found to be more acceptable by the students and teachers respectively residing in Jabalpur district. Likewise malted drink of kutki millet and sweet ball of puffed kutki millet were found to be more acceptable by the teachers and students respectively residing in Dindori district. The new cooking recipes from minor millets have great potential as protein and minerals rich supplementary foods to alleviate Protein Calories Malnutrition (PCM) and mineral deficiency diseases prevalent among school going children.

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