DOI: *10.15613/fijrfn/2024/v11i2/47837*
ISSN (Print) : 2349-8897
***FoodSci*: Indian Journal of Research in Food Science and Nutrition,** *Vol 11(2), 47-52, July-December 2024* *ISSN (Online) : 2350-1006*

Formulation and Quality Analysis of Millet Based Waffles

P. Indumathy* and R. Kausika Varshini

Department of Foods and Nutrition, Vellalar College for Women, Erode - 638012, Tamil Nadu, India; indumathy@vcw.ac.in

Abstract

Millets are group of small grained cereal food crops which are highly nutritious. The present study aimed to formulate an appetizing healthy waffle using millets flour (suchasragi, black rice and bajra and oats flour), seeds (such as halim, flax and pumpkin) and brown sugar and the formulated waffles were compared with commercial waffles. Both millet based waffles and commercial waffles were subjected to organoleptic evaluation by 25 semi-trained panelists. The mean overall acceptability score of millet based waffles was higher and it was better than commercial waffles because all the characteristics like appearance, color, taste, flavor and texture received higher score. The nutrient content of millet based waffles and commercial waffles were analyzed and the results showed that millet based waffles had slightly higher amounts of all the nutrients (such as protein, dietary fiber, calcium, magnesium and iron) than commercial waffles. The phytochemical components such as alkaloids, flavonoids, steroids, phenol and tannin were found to be present in millet based waffles. The physicochemical properties such as ash, pH, moisture, true density, bulk density and porosity were analyzed for both commercial waffles and millet based waffles. The cost of one set of millet based waffles was slightly higher than commercial waffles.

Keywords: Dietary Fiber, Millets, Waffle, Nutritive Value, Physicochemical Properties, Sensory Evaluation

1. Introduction

Millets are group of small grained cereal food crops which are highly nutritious and grown under marginal or low fertile soils with very low inputs such as fertilizers and pesticides. These crops largely contribute to food and nutritional security of the country. Most of millet crops are native of India and popularly known as nutri-cereals as they provide most of the nutrients required for normal functioning of human body. Based on area grown and its grain size, the millets are classified as major millet and minor millets. The major millets include sorghum (jowar) and pearl millet (bajra). The finger millet (ragi), foxtail millet, little millet, kodo millet, barnyard millet, proso millet and brown top millet are categorized under minor millets[1].

Although millets are one of the world's most important food crops, it is cultivated mostly in the Eastern hemisphere and particularly in regions with primitive agricultural practices and high population densities[2,3]. Pearl millet is commonly known as Bajra and it is the sixth major cereal in terms of area and production. It has the highest drought tolerance potential of all millets. It is the most widely cultivated cereal in India after rice and wheat. It is rich in essential compounds like protein, fibre, phosphorous, magnesium and iron. Due to its rich composition of minerals and proteins, pearl millet has many health benefitting properties[1,4].

Finger millet or ragi are very small and are light brown or dark brown or white in colour. The grains of finger millet are rich in quality protein having high amounts of tryptophan, cysteine, methionine, fibre (10-15 % dietary fibre), phytochemicals, calcium and other minerals. It also has excellent malting properties and widely used as weaning foods[1,5].

Hence, the present study was undertaken to formulate an appetizing healthy waffle using millets and to compare the nutrient content of formulated waffles with the commercial waffles.

**Author for correspondence*

2. Materials and Methods

2.1 Selection and Procurement of Raw Materials

In the present study ragi flour, bajra flour, black rice flour, oats flour, halim seeds,flax seeds, pumpkin seeds, cocoa powder, brown sugar, vanilla essence, egg and milk were selected to make millet based waffles[6,7]. The raw materials were procured from a department store. They were checked visually to be free from infestation.

2.2 Equipment Used for Preparation of Waffles

A waffle maker or waffle iron is a unique cooking appliance that helps give waffles their signature diamond pattern. The machine consists of two plates on a hinge. The two plates are both imprinted with the iconic diamond pattern. The material of the two plates varies depending on the specific type of waffle maker, though it is often a metal with a nonstick coating. The waffle maker can cook the waffle batter quickly and the nonstick coating gives waffle without issue. The design of the two plates on a hinge lets press the batter to cook it. With a waffle maker, the batter is enclosed, which helps cook it evenly and results in a fluffy texture. A waffle maker is a modern version that is more widely used today. The waffle maker uses electricity and heats up quickly[8].

2.3 Preparation of Commercial Waffles

The proportion of ingredients used in the preparation of commercial waffles are listed in Table 1. In a large bowl, mix Maida flour, corn flour, powdered white sugar, baking soda, baking powder and corn flour together and set aside. In a separate bowl, beat the egg, milk and vanilla essence together. Pour the wet mix into the dry mix and beat it well. Preheat the waffle maker for 10 minutes. Grease the oil or butter in the mold of waffle maker and ladle the batter into it and bake it for 15 to 20 minutes until waffles reach deep brown and crisp. Serve warm and crispy waffle with Hershey's cocoa spreads[9].

2.4 Preparation of Millet Based Waffles

The proportion of ingredients used in the preparation of millet based waffles are listed in Table 2. In a large bowl, mix all the millets flour, oats flour, corn flour, brown sugar, baking soda, baking powder and cocoa powder together and set aside. Add all the seeds in crushed form into the dry mix. In a separate bowl, beat the egg, milk and vanilla essence together. Pour the wet mix into the dry mix and beat it well. Preheat the waffle maker for 10 minutes. Grease the oil or butter in the mold of waffle maker and ladle the batter into it and bake it for 15 to 20 minutes until waffles reach crisp. Serve warm and crispy waffle with Hershey's cocoa spreads.

Table 1. Proportion of ingredients used in commercial waffles

Si. No.	Ingredients	Amounting
1	Maida flour	150
2	Corn flour	20
3	Powdered white sugar	70
4	Baking soda	2
5	Baking powder	3
6	Cocoa powder	10
7	Milk	200(200 ml)
8	Vanilla essence	10(10 ml)
9	Egg	100 (2 no.)
Total		570

Table 2. Proportion of ingredients used in millet based waffles

Si. No.	Ingredients	Amounting
1	Ragi flour	20
2	Bajra flour	20
3	Black rice flour	20
4	Oats flour	20
5	Corn flour	20
6	Halim seeds	5
7	Flax seeds	5
8	Pumpkin seeds	5
9	Brown sugar	130
10 Baking soda		2
11	Baking powder	3
12	Cocoa powder	10
13	Milk	200(200 ml)
14	Vanilla essence	10(10 ml)
15	Egg	100(2 no.)
Total		570

2.5 Sensory Evaluation

Both commercial waffles and millet based waffles were organoleptically evaluated by 25 semi trained panel members for appearance, colour, texture, flavour, taste and overall acceptability. Hedonic rating test was used for the evaluation of overall acceptability. In continuation with sensory quality assessment, two sample difference test is used to test the sample whether it may or may not be different from the reference sample. Also to determine the degree and direction of difference on the scale of no difference to large difference and for testing the directions, the scale used is superior to Standard (S), Equal to standard (E) and Inferior to standard (I). The differences are based on the criteria like appearance, taste, flavour, colour and overall acceptability[10]. Hence the sample difference was tested using two difference test.

2.6 Physicochemical Properties of Waffles

The ash content, moisture content, pH, true density, bulk density and porosity were analyzed for both commercial waffles and millet based waffles using standard procedures.

2.7 Nutrient Evaluation

The nutritive value of commercial waffles and millet based waffles were analyzed such as protein, dietary fiber, calcium, magnesium and iron.

2.8 Phytochemical Analysis of Waffles

The phytochemicals such as steroids, flavonoids, alkaloids, phenol and tannin were analyzed for both commercial waffles and millet based waffles using standard procedures.

3. Results and Discussion

3.1 Yield of Waffles

The dry ingredients like flours (ragi, bajra, oats, and black rice), corn flour, cocoa powder, crushed seeds (halim, flax and pumpkin) and brown sugar are used to prepare millet based waffles. In commercial waffles preparations, maida flour, cornflour, cocoa powder and powdered white sugar were used. Then all the dry ingredients are mixed well with wet ingredients like milk, egg and vanilla essence to bring it into batter consistency. The yield of waffles from 600g of batter is represented in the Table 3. Six set of waffles were obtained from 600g of batter for both the commercial and millet based waffles. The weight of each set of waffles was 100g.

3.2 Sensory Evaluation of Millet Based Waffles

The mean scores obtained through organoleptic evaluation of commercial waffles and millet based waffles are discussed below. The mean score for the acceptability of standard and millet based waffles through hedonic rating test are given in Table 4. The two sample difference test for millet based waffles with standard commercial waffles are given in Table 5.

Table 4 represents that, the mean overall acceptability of millet based waffles were higher and better than commercial waffles because all the characteristics like appearance, colour, taste, flavor and texture received higher score from all the 25 panel members. It was highly accepted by everyone. The difference was significant at 1%. Table 5 shows that the sensory evaluation of millet based waffles obtained by degree of difference test among different panelist showed that large degree of difference in relation to appearance, colour, taste, texture, flavour and overall acceptability. Among them the major results for appearance, colour, taste, flavour and overall acceptability were superior to standard and texture was inferior to that of standard. In general, the degree of liking for millet based waffles were higher than the score given to commercial waffles.

3.3 Physicochemical Properties of Waffles

The physicochemical properties such as ash, pH and moisture of both commercial waffles and millet based waffles are analysed in the form of waffles in the laboratory. The true density, bulk density and porosity of both commercial waffles and millet based waffles are analysed in the form of flour in the laboratory and the value of these parameters are given in the Table 6.

Table 3. Yield of waffles

Waffles	Set of Waffles from 600g of Batter	Weight Perset(g)
Commercial waffles	6	100
Millet based waffles	6	100

Table 4. Mean scores for commercial waffles and millet based waffles

Criteria	Mean±Standard Deviation		't'value
	Commercial Waffles	Millet based Waffles	
Appearance	8.28±0.4	9±0	9.35**
Colour	8.2±0.4	8.92±0.4	6.36**
Taste	8.16±0.37	8.92±0.4	6.97**
Texture	8.64±0.48	8.92±0.4	2.24*
Flavour	8.04±0.2	8.92±0.4	9.88**
Overall acceptability	8.08±0.27	9±0	17.03**

**Significantat1% level
*Significant at 5% level

Table 5. Two sample difference test for millet based waffles with standard commercial waffles

Criteria	Degree	Score	Direction	Number of Subjects	Percentage
Appearance	1 2 3 4	0 1 2 3	I E S	0 7 18	- 28 72
Colour	1 2 3 4	0 1 2 3	I E S	1 4 20	4 16 80
Taste	1 2 3 4	0 1 2 3	I E S	1 3 21	4 12 84
Texture	1 2 3 4	0 1 2 3	I E S	1 15 9	4 60 36
Flavour	1 2 3 4	0 1 2 3	I E S	1 0 24	4 - 96
Overall acceptability	1 2 3 4	0 1 2 3	I E S	0 2 23	- 8 92

1-No difference, 2-Very slightly difference, 3-Moderate difference, 4-Large difference, I-Inferior to standard, E-Equal to standard, S-Superior to standard

Finally Table 6 reported that, the ash content of millet based waffles were slightly higher than commercial waffles, the moisture content of millet based waffles were lower than commercial waffles, the true density value of millet based waffles were slightly lower than commercial waffles and the porosity of millet based waffles were lower than commercial waffles. Both millet based waffles and commercial waffles had same pH and bulk density.

3.4 Nutrient Content of Waffles

The nutrient content of 100g of commercial waffles and millet based waffles are analysed in the laboratory and presented in Table 7.

The protein content of commercial waffles and millet based waffles were found to be 8.7g and 11.2g respectively. Both the commercial waffles and millet based waffles had 2.5g and 3.3g as their dietary fibre and 75mg and 84mg as their calcium content respectively. The magnesium content of commercial waffles and millet based waffles were found to be 31mg and 45mg respectively. The iron content of commercial waffles was found to be 1.6mg, where as the millet based

Table 6. Physicochemical properties of waffles

Parameters	Commercial Waffles	Millet Based Waffles
Ash (%)	2.1	2.3
pH	7	7
Moisture (%)	20	6.1
True density (g/ml)	1.42	1
Bulk density (g/ml)	0.66	0.66
Porosity	53.52	34

Table 7. Nutrient content of waffles per 100g

Nutrients	Commercial Waffles	Millet Based Waffles
Protein(g)	8.7	11.2
Dietary fibre(g)	2.5	3.3
Calcium(mg)	75	84
Magnesium(mg)	31	45
Iron(mg)	1.6	2.3

waffles had 2.3mg. Thus the nutrient contents were slightly higher in millet based waffles than commercial waffles.

3.5 Phytochemicals Present in Waffles

The phytochemicals present in both commercial waffles and millet based waffles are analysed in the form of flours in the both ethanol extract and aqueous extract. The results are represented in the Table 8.

Table 8. Phytochemicals present in commercial waffles and millet based waffles

Phyto chemicals	Commercial Waffles		Millet Based Waffles	
	Ethanol Extract	Aqueous Extract	Ethanol Extract	Aqueous Extract
Alkaloids	-	-	+	+
Flavonoids	+	+	+	+
Steroids	+	+	+	+
Phenol	-	-	+	+
Tannin	-	-	+	+

+Presence, -Absence

Table 9. Cost of commercial waffles for 600g of batter

Ingredients	Quantity (g)	Cost of Each Ingredient (Rs.)
Maida flour	150	12.60
Corn flour	20	2.80
White powdered sugar	75	4.00
Cocoa powder	10	10.00
Baking soda	2	1.00
Baking powder	3	1.50
Vanilla essence	10(10 ml)	4.00
Milk	200(200 ml)	12.00
Egg	100 (2 Nos)	12.00
Oil	25 ml	5.00
Waffle maker	-	5.00
Electricity	1.5 unit	14.00
Labour charge	1	50.00
Printed butter paper or plain butter paper	6 paper	60.00
Folding carton style box	6 boxes	240.00
Total Cost		**434.00**

The phytochemicals such as alkaloids, flavonoids, steroids, phenol and tannin were found to be present in millet based waffles. But alkaloids, phenol and tannin were absent in commercial waffles.

3.6 Cost Calculation of Waffles

The cost is mainly calculated on the basis of price of ingredients and equipments used for preparation, packaging, electricity and labour charge. The cost calculation of commercial waffles and millet based waffles for 600g of batter are presented in Table 9 and

Table 10. Cost of millet based waffles for 600g of batter

Ingredients	Quantity (g)	Cost of Each Ingredient (Rs.)
Ragiflour	20	2.00
Bajra flour	20	3.00
Black rice flour	20	9.00
Oats flour	20	8.00
Corn flour	20	2.80
Halim seeds	5	3.00
Flax seeds	5	3.00
Pumpkin seeds	5	6.00
Brown sugar	130	8.00
Cocoa powder	10	10.00
Baking soda	2	1.00
Baking powder	3	1.50
Vanilla essence	10 (10 ml)	4.00
Milk	200 (200 ml)	12.00
Egg	100 (2 Nos)	12.00
Oil 25 ml 5.00		
Waffle maker	-	5.00
Electricity	1.5 unit	14.00
Labour charge	1	50.00
Printed butter paper or plain butter paper	6 paper	60.00
Folding carton style box	6 boxes	240.00
Total Cost		**460.00**

Table 11. Cost comparison of commercial waffles and millet based waffles (per 100g)

Product Name	Quantity (100g)	Cost (Rs.)	Hershey's Cocoaspread (Rs.)	Total Cost (Rs.)	Total Cost with 40% Profit
Commercial waffles	1set	73	45	118	200
Milletbased waffles	1set	77	45	122	210

10 respectively. The cost of each commercial and millet based waffles are compared in Table 11.

Table 11 shows that, the price of one set of commercial waffles and millet based waffles were Rs.73 and Rs.77 respectively. The price of one set of commercial waffles with toppings (Hershey's cocoa spread) was Rs.118/- and that of millet based waffles with toppings was Rs.122/-. Total cost of one set of commercial waffles with toppings was Rs. 200/- (with 40% profit). Total cost of one set of millet based waffles with toppings was Rs. 210/- (with 40% profit). The cost of one set of waffles with Hershey's cocoa spread in the waffle shop was Rs. 200/- (with 40% profit).

4. Conclusion

From the above study, it is concluded that millet based waffles received maximum score for sensory evaluation and it was accepted by the panel members due to the good appearance, colour, taste and flavour. The millet based waffles had higher nutritional value in terms of protein, dietary fibre, calcium, magnesium and iron than commercial waffles. So, the millet based waffles can be consumed by all age groups. While comparing the cost of one set of millet based waffles with commercial waffles, it was slightly higher but considering its nutritive value, it could be easily accepted by everyone.

5. References

1. Bhat BV, Rao BD, Tonapi VA. Understanding millets-Pearlmillet and finger millet. 2018:1-5.
2. Changmei S, Dorothy J. Millet- the frugal grain. International Journal of Scientific Research and Reviews (IJSRR). 2014; 3(4):75-90.
3. Hassan ZM, Sebola NA, Mabelebele M. The nutritional use of millet grain for food and feed: A review. Agriculture and Food Security. 2021; 10(16):1-14. https://doi.org/10.1186/s40066-020-00282-6
4. Gupta V, Singh AP, Gupta N. Importance of pearl millet and its health benefits. Just Agriculture multidisc Newsletter. 2022; 2(7):1-3.
5. Lahiri B, Rani R. Garden cress seeds: Chemistry, medicinal properties, application in dairy and food industry- A review. Emergent Life Sci Res. 2020; 6(2):1-4. https://doi.org/10.31783/elsr.2020.620104
6. Prasad BJ, Sharavanan PS, Sivaraj R. Health benefits of black rice. Grain Oil Sci Technol. 2019; 2:109-113.
7. Ceclu L, Nistor OV, Mocanu GB. Pumpkin- health benefits. J Agroaliment Processes Technol. 2021; 26(3):241-246.
8. Available from: https://bigtimekitchen.com/waffle-maker-cooking-complete/
9. Groskreutz R. 33 best waffle toppings: Sweet and savory ideas; 2022. Available from: https://cookingchew.com/waffle-toppings.html
10. Srilakshmi A. Texture profile analysis of food and TPA measurements: A review article. International Research Journal of Engineering and Technology (IRJET), 2020; 7(11):708-711.