

Formulation Of Cereal-Based Beverage Enriched With Vitamin C, Dietary Fibers And Micronutrients

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Abstract: The present study focused on production of a plant-based beverage enriched with Vitamin C, dietary fibers and micronutrients. The study involves the formulation of beverage where major ingredients used were barley and finger millet (ragi) to improve the calcium intake in our diet. The formulated cereal-base beverages (B1 and B2) were also enriched with dietary fibers, proteins and other minerals. There was also a presence of selenium which acts as an antioxidant and also prevents inflammation. Daily requirement of vitamin C is also fulfilled by this beverage. Ragi and barley are soaked in water for 1-6 hours to obtain calcium, magnesium and other minerals enriched water. The nutritional composition of cereal-base beverage (B1) per 100 ml was found to have Moisture (82.50%), Protein (1.20 g), Carbohydrates (15.7 g), Total Sugar (16.5 g), Ash (0.50%), Fat (0.1 g) Calcium (12.2 mg), Magnesium (8.35 mg), Vitamin C (40.2 mg), Dietary fiber (3.2 g) and total energy (68.5 Kcal). While the nutritional composition of beverage B2 per 100ml had Moisture (82.35%), Protein (0.80 g), Carbohydrates (16.26 g), Total Sugar (10.4 g), Ash (0.50%), Fat (0.1 g) Calcium (12.0 mg), Magnesium (5.1 mg), Vitamin C (12.6 mg), Dietary fiber (1.82 g) and total energy (69.14 kcal). Thus, this product can be a potential source of good nutrition to the consumers.

IndexTerms -Cereal based beverages, finger millet, barley, vitamin C.

I. INTRODUCTION

In past few decades, India is evolving as a huge market for juice industry and trade. The increase in consumer demands and changing lifestyle fosters the juice industry. In the world of technological development and its fast pace, the consumers are starting to move towards time saving options of lifestyle; which is why beverages are becoming increasingly popular in all age groups. This surge in popularity is due mainly to changing consumer consumption habits and a shift away from traditional beverages like soft drinks and beer. There are different types of the beverages available in market milk-based, water-based, and some of them are enriched with proteins or minerals and vitamins. Consumers are increasingly becoming more health conscious, and they are willing to try new, healthier alternatives for obtaining wholesome nutrition (Fernandes et al., 2018).

Cereal drinks have a fine variety to be classified as functional beverages by mixing the goodness of multi grains in an aqueous medium. By using multiple grains, various bioactive components get included in the final product (Fernandes et al., 2018). To be categorized as a healthy and functional drink, bioactive components such as dietary fiber, vitamins, minerals, phytochemicals, carotenoids, probiotics, antioxidants, etc. should be a sure source. The rightful blending of juice will improve the taste and nutrients of the beverages resulting in the production of delightful and delicious drinks with advances in organoleptic properties and nutritional value (Singh and Gaikwad, 2012).

Barley is primarily used in alcoholic beverages as an essential component, most commonly in beer. Besides malt, it was used as an animal feed. Yet barley is gaining popularity as an ingredient in functional foods in recent times because of the presence of bioactive compounds in it (Kulkarni A. et al., 2008). Barley is known for its soluble dietary fiber content and the β -glucan fiber is responsible for the health benefits of barley (Idehen E. et al., 2017). Dietary fibers aid in the removal of harmful toxins from the human body to prevent colon diseases. In their study, Dutta et al. 2018 cited Behall et al. 2004 that β -glucan fiber has been associated to lower the plasma cholesterol, increase lipid metabolism, and boost glycemic index. Besides being rich in dietary fiber, barley is abundant in minerals such as selenium, magnesium and many more.

Ragi is 30 times richer in calcium compared with wheat and rice (Srivastava and Sharma, 2012). It is a rich source of calcium (0.34%), dietary fiber (18%), phytates (0.48%), protein (6%-13%), minerals (2.5%-3.5%) and phenolics (0.3%-3%). It also contains strong concentrations of thiamine, riboflavin, iron and essential amino acids, which improves finger millet's nutraceutical capacity (Bansal and Kaur, 2018).

Even in the ever-growing beverage industry, cereal drinks are often uncommon in thinking. Wheat and rice are known as India's staple food grains, but there are many cereals that are only used in traditional recipes, such as finger millet porridge. Yet in the younger generation now-a-days any of these traditional recipes do not strike a chord. Traditionally processed foods have a poor scientific consideration and their commercialization is constrained (Jain et al., 2017).

Hence sincere efforts have been made to formulate the cereal-base beverage loaded with vitamins, minerals, dietary fibers and protein which can be considered as a "go-to" drink for people living a fast-paced lifestyle. The cereal-base beverage B1 is enriched with lemon and ginger to counter the Vitamin C deficiency and also to have a refreshing taste. The B2 beverage is formulated with another flavor which is the authentic kala khatta flavor. Kala khatta syrup is obtained from concentrating jamun (Indian blackberry) juice.

II. RESEARCH METHODOLOGY

2.1 Materials

2.1.1 Raw Materials

For the production of the cereal-base beverage, the base was barley water and finger millet water. Whole barley and finger millet, along with lemons, ginger, sugar and kala khatta syrup was obtained from the local market, Loni Kalbhor, Pune. PET bottles for packaging of the beverage were also procured from the Pune city Market (200 ml capacity)

2.1.2 Chemicals

Chemicals of analytical grade were made available in the laboratories of MIT College of Food Technology.

2.2 Methods

2.2.1 Preparation of barley water

Barley water was prepared by boiling the barley grains and extracting the water (Dutta et al. 2018). Barley water was prepared by a method described by Duh et al. (2001) with slight modifications. Barley was first soaked in water for 5 to 6 hours and then the grains were boiled with separate batch of water in the ratio of 1:10 for 1 hour and filtered to obtain a clear extract. Barley grains were not roasted prior for extraction as this would enhance the antioxidant efficiency and amino acid profile as compared to roasted barley grain extract (Duh et al., 2001).

2.2.2 Preparation of ragi water

Ragi was soaked in water for 45 minutes to an hour and the resulting filtrate was boiled for 10 minutes.

2.2.3 Preparation of beverage

Barley water and ragi water were added according to the formulation given in Table 01.

1. For the first beverage (B1), sugar was added to the waters and stirred until it dissolved completely. Lemon juice and ginger juice were added according to the formulation. 100 ppm Sodium benzoate (E211) was added to the beverage. The beverage was mixed thoroughly to obtain a homogenous solution. It was pasteurized at 65°C for 10 minutes and filled in pre-sterilized PET bottles.
2. For the next beverage (B2), kala khatta syrup (premade, TSS: 65°Bx) was added to the waters according to the formulation and stirred to obtain a homogenous solution. 100 ppm Sodium benzoate (E211) was added to the beverage. It was pasteurized at 65°C for 10 minutes and filled in pre-sterilized PET bottles.

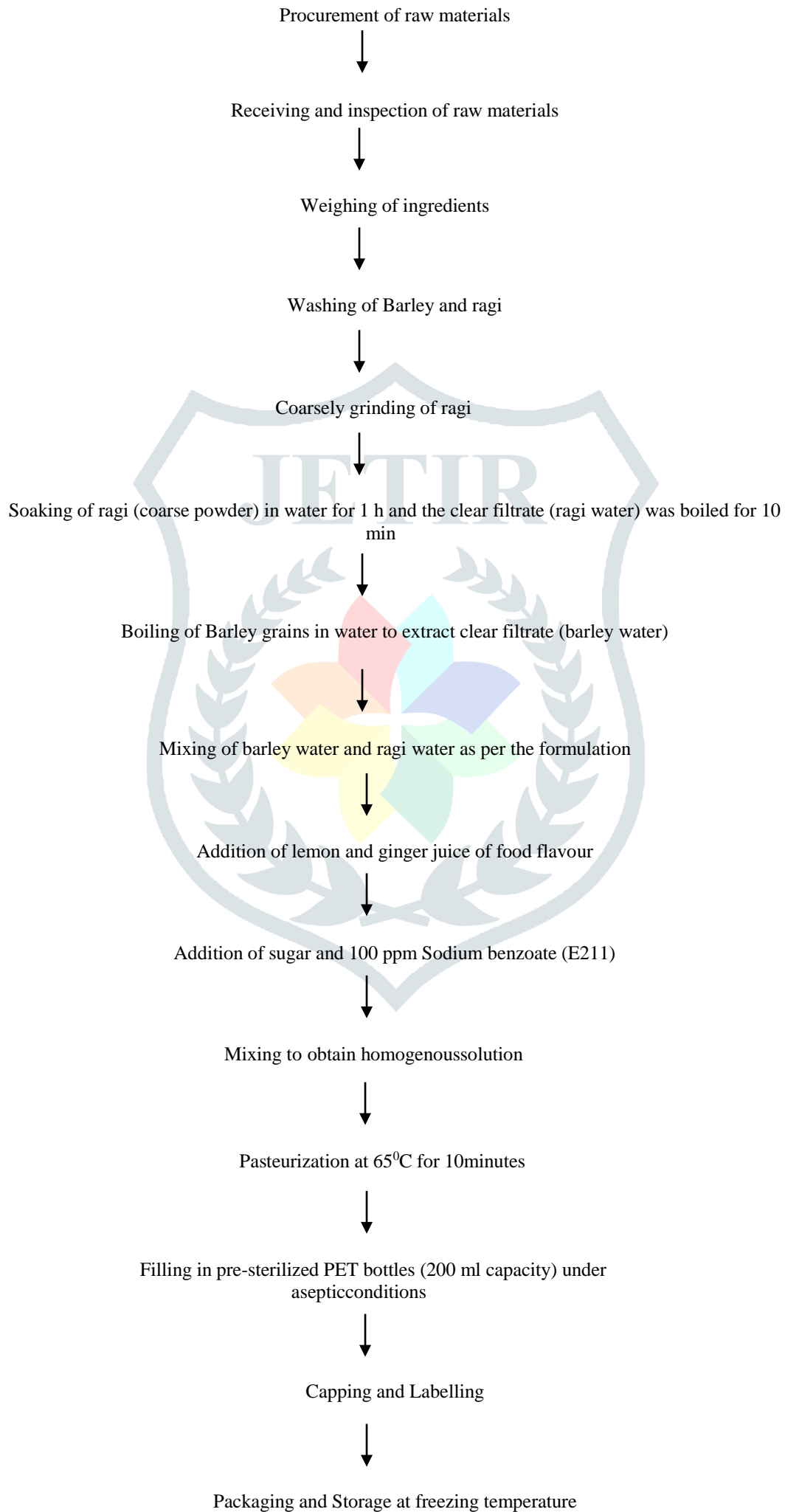
2.2.4 Formulation of beverages

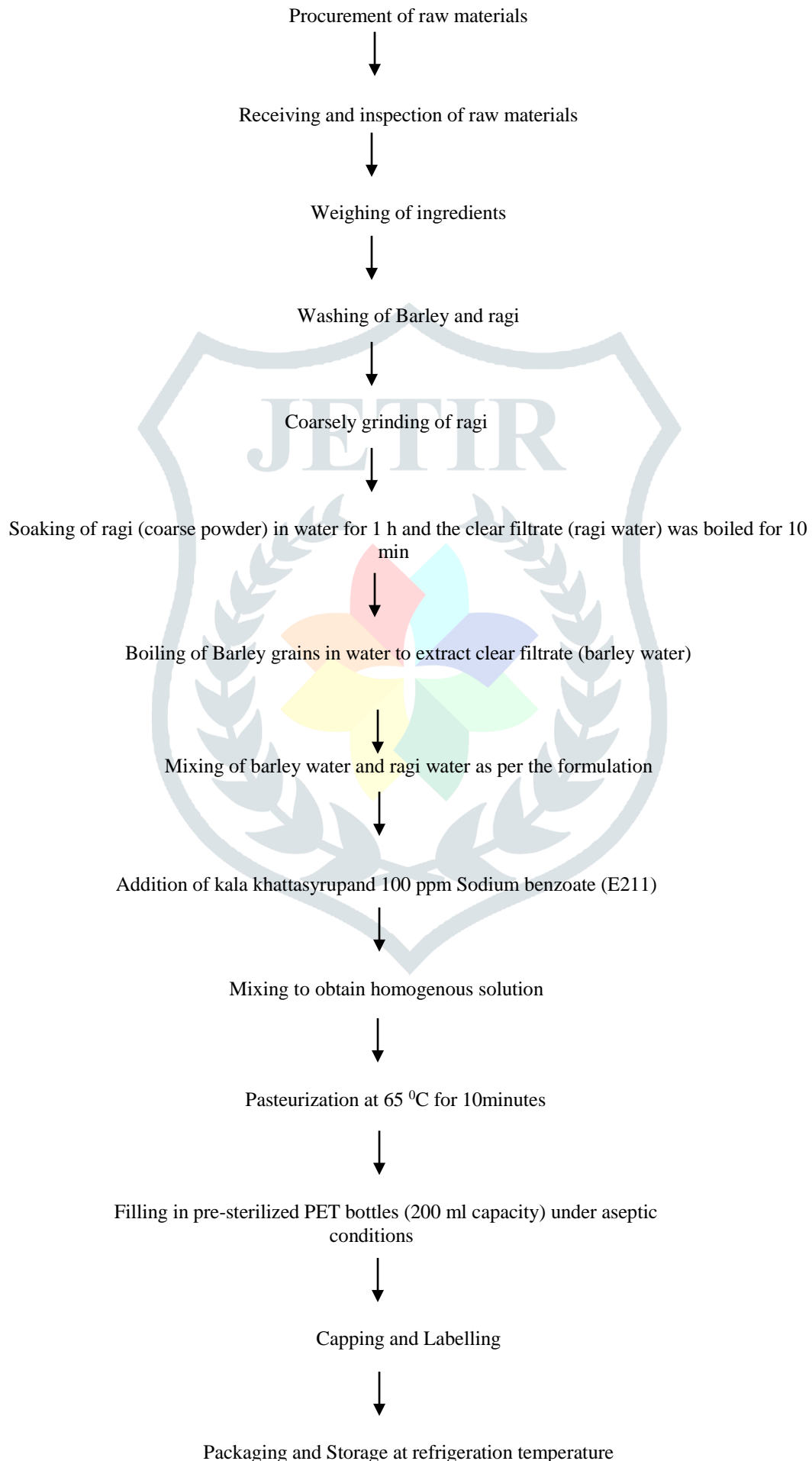
Formulation of Beverages(B1 and B2) were prepared as per given in table I.

Sr. No.	Ingredients	Quantity (For 1 L)	
		Beverage (B1)	Beverage (B2)
1	Barley water	420 ml	440 ml
2	Ragi water	440 ml	440 ml
3	Sugar	82 g	-
4	Lemon juice	50 ml	-
5	Ginger juice	8 ml	-
6	Kala Khatta Syrup	-	120 ml
7	Sodium benzoate	100 ppm	100 ppm

Table I: Formulation of beverages (B1 and B2) per 1 L

2.2.5 Process Flow diagram (For B1 Beverage)



2.2.6 Process flow diagram (For B2 beverage)

2.3 Analytical methods

2.3.1 Sensory evaluation of Beverages

The sensory evaluation for prepared beverages (B1 and B2) of different organoleptic characteristics i.e., colour and appearance, mouth feel, taste, flavor and overall acceptability were carried out by semi-trained panellists on 9-point hedonic scale. The average score was calculated for individual organoleptic properties for various quality attributes, where 9 stands for like extremely, 5 is neither like nor dislike, and 1 is dislike extremely as described by Amerine *et al.* (1965)

2.3.2 Proximate analysis of beverages:

Sr. No.	Parameters	Analytical Methods
1	Energy Value	Calculation
2	Moisture	Dry Oven Method
3	Ash	Muffle furnace
4	Fat	Soxhlet Method
5	Protein	Micro-Kjeldahl Method
6	Carbohydrates	Difference Method
7	Dietary Fiber	IS: 11062:2010
8	Calcium	Colorimetric Method
9	Vitamin C	Indophenol Dye Method

Table II: Analytical methods used for proximate analysis

III RESULTS AND DISCUSSION

3.1 Sensory Evaluation of prepared beverages (B1 and B2):

Beverages prepared with different formulations were subjected for sensory evaluation to evaluate maximum acceptability of the product. The obtained results are presented in the Table III. The data revealed that the control got the lowest sensory scores with an overall acceptability of 5 due to its bland taste. Beverage (B1 and B2) containing flavors were able to mask the bland taste of control and hence got significantly more overall acceptability scores of 8. In terms of odor, the refreshing smell of lemon with a hint of ginger had a score of 9, as compared to beverage (B2) with a score of 8. In terms of mouth feel however, beverage (B2) scored higher than beverage (B1).

Sr. No.	Parameters	C	B1	B2
1	Colour and appearance	5	8	9
2	Taste	4	8	7
3	Odor	4	9	8
4	Flavor	3	8	9
5	Mouth feel	4	7	8
6	Overall acceptability	5	8	8

C: Control, Barley water and ragi water only
 B1: Beverage 1, Barley water and ragi water enriched with lemon and ginger juice
 B2: Beverage 2, Barley water and ragi water enriched with kala khatta syrup

Table III: Sensory evaluation

3.2 Proximate composition of prepared beverages (B1 and B2):

The prepared beverages were further analyzed for proximate composition and obtained results are depicted in Table IV and V. The cereal-base beverage (B1) enriched with lemon and ginger contained 82.50% moisture, 1.20 g protein, 15.70 g carbohydrates, 16.5 g total sugar, 0.10 g fat and 0.50% ash, 12.2 mg Calcium, 8.35 mg Magnesium, 40.2 Vitamin C and 3.2 g dietary fiber per 100ml. Normally, water-based beverages contain very little to no protein, but this beverage contained 1.20 g protein. This may be contributed by the hydrophilic amino acids present in finger millet and barley. The beverage contained very low amount of fat (0.1 g). The end TSS of the beverage was maintained at 12°Bx.

Sr. No.	Nutritional parameters	Results (per 100 ml)
1	Total energy	68.5 kcal
2	Moisture	82.50%
3	Protein	1.20 g
4	Carbohydrates	15.7 g
5	Total Sugar	16.5 g
6	Ash	0.50%
7	Fat	0.1 g
8	Calcium	12.2 mg
9	Magnesium	8.35 mg
10	Vitamin C	40.2 mg
11	Dietary fiber	3.2 g
*Each value is the average of three determinations.		

Table IV: Nutritional composition of Beverage B1

The cereal-base beverage (B2) enriched with kala khatta flavor, contained 82.35% moisture, 0.80 g protein, 16.26 g carbohydrates, 10.4 g total sugar, 0.1g fat, 0.50% ash, 12 mg Calcium, 5.1 mg Magnesium, 12.6 Vitamin C and 1.82 g dietary fiber per 100 ml. The higher proportion of carbohydrates in this beverage was contributed by the use of kala khatta syrup of TSS 65°Bx. The end TSS of the beverage was 14.5°Bx.

Sr. No.	Nutritional parameters	Results (per 100 ml)
1	Total energy	69.14 kcal
2	Moisture	82.35%
3	Protein	0.80 g
4	Carbohydrates	16.26 g
5	Total Sugar	10.4 g
6	Ash	0.50%
7	Fat	0.1 g
8	Calcium	12 mg
9	Magnesium	5.1 mg
10	Vitamin C	12.6 mg
11	Dietary fiber	1.82 g
*Each value is the average of three determinations.		

Table V: Nutritional composition of Beverage B2

The dietary fiber content of Beverage (B1 and B2) was determined to be 3.2 g and 1.82 g per 100 ml respectively. The Vitamin C content of Beverage(B1 and B2) was determined to be 40.2 g and 12.6 g per 100 ml respectively. There is major difference between the vitamin C content in both the beverages may be due to the use of lemon and ginger in the first beverage contributing to the high vitamin C content per 100 ml.

The calcium and magnesium content of Beverage (B1) was determined to be 12.2 mg and 8.35 mg per 100 ml respectively. In Beverage (B2), the calcium content was found to be 12 mg per 100 ml and magnesium content was 5.1 mg per 100 ml. The calcium content of both the beverages were very much similar, indicating that the source of calcium content is mainly finger millet, followed by barley.

IV CONCLUSION

Calcium in water-based beverages is practically unheard of, and a range of 120-122 mg/L of calcium in the beverages was obtained. Further research on soaking time and temperatures may help in increasing the calcium and other micronutrient content in the beverage. Dietary fibers were found abundantly, with 3.2 g/100 ml in the lemon and ginger beverage. The amount of 25%

of the required daily intake (25 g) of dietary fibers by just consuming 200 ml of the beverage every day. 200 ml of kala khatta beverage fulfilled around 14.5% of the dietary fiber daily intake. As a general guideline, for every 1000 calories, 14 g dietary fiber is obtained. But this beverage decreases the intake of calories and increases the amount of dietary fiber obtained. The required daily intake for Vitamin C is 75 mg for women and 90 mg for men (FDA). By consuming 200 – 250 ml of cereal-base beverage enriched with lemon and ginger, fulfills the entire daily value for Vitamin C. The 200 ml of beverage enriched with kala khatta fulfills around 32% of daily intake of Vitamin C. This helps to keep diseases like scurvy at bay. Apart from this, both the beverages were loaded with micronutrients like calcium and magnesium.

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