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Sensory and nutritional evaluation of beverages developed using malted ragi (*Eleusine coracana*) supplemented with cantaloupe juice

Arisha Ashraf and Neha Sharma

Abstract

Finger Millet based sports beverages were developed by supplementing malted ragi with Cantaloupe juice and were organoleptically evaluated for sensory attributes by semi-trained panel of 5 judges. Control samples were developed by using milk, cantaloupe and honey and in test samples malted ragi was added at different levels ranging from 5-15 percent. In terms of all sensory qualities, the results showed that the cantaloupe-based malted ragi beverage supplemented with 5% malted ragi was quite acceptable overall. The most widely accepted amount was chemically examined using a standard procedure to determine its approximate composition, amino acids, vitamins, minerals, readily available carbs, and additional components. The most acceptable malted ragi cantaloupe beverage was estimated to have 5 ± 0.03 g crude protein, 2.31 ± 0.51 g of crude fat, 1.5 ± 0.05 g of crude fibre, 20.65 ± 1.09 g of carbohydrates, 129.4 mg of calcium, 0.05 mg of iron, 93.2 mg of phosphorus and 0.386 mg of zinc, vitamin A: 4170 IU, vitamin C: 60 ± 1.5 mg, potassium: 417 mg per 100 ml. The anti-nutritional components were 115.6 ± 9.5 mg of phytates, 12.1 ± 2.5 mg of total phenols and 0.41 ± 0.01 mg of trypsin inhibitor activity. Total sugars were found to be 4.59 ± 0.29 g, 3.45 ± 0.25 g of reducing sugars, 3.12 ± 0.15 g of non-reducing sugars and 0.97 ± 0.05 g of starch. Results showed that malted ragi can be successfully used up to a 5 percent level to make beverages with high nutritional value without having an unfavorable impact on sensory qualities, which may be beneficial in the field of sports and for sportsman.

Keywords: Beverage, nutritional evaluation, finger millet, sportsperson

Introduction

Sportspersons, engaged in high-intensity physical activities, require optimal nutrition to support their performance, endurance, and overall well-being. Adequate nutrient intake is crucial for sustaining energy levels, promoting muscle recovery, and enhancing physical performance. In recent years, there has been growing interest in exploring alternative and natural food sources that can provide a comprehensive range of nutrients. One such promising option is the combination of finger millet and cantaloupe, which offers a unique blend of nutritional benefits for sportspersons. In recent years, the sports nutrition industry has witnessed a surge in the demand for natural and plant-based dietary solutions. Sportspersons, in particular, are increasingly seeking alternatives to synthetic supplements and processed foods, focusing on whole foods that provide a wide array of nutrients in their natural form. In this context, the combination of finger millet (*Eleusine coracana*) and cantaloupe (*Cucumis melo*) presents a unique opportunity to develop a nutritional beverage that caters specifically to the needs of sportspersons.

Finger millet (*Eleusine coracana*), commonly known as ragi, is a cereal crop that has been traditionally cultivated and consumed in many parts of the world, especially in Africa and Asia. It is highly regarded for its nutrient-dense makeup, which includes significant amount of dietary fibre, vital amino acids, minerals (including calcium, iron, and magnesium), and vitamins (such as vitamin E and B-complex vitamins). These nutritional components are crucial for enhancing endurance, facilitating muscle recovery, and promoting overall health, making finger millet an ideal ingredient for sportspersons' dietary requirements (Fakayode, 2016; Kaur & Arora, 2020) [11, 18]. The nutritional profile of finger millet makes it a fantastic option for boosting stamina, accelerating recovery, and promoting general health. Finger millet has gained recognition as a valuable crop due to its impressive nutritional profile. Rich in dietary fiber, it aids in digestion, regulates blood sugar levels, and promotes satiety, which can be beneficial for sportspersons seeking to maintain a healthy weight. Additionally, finger millet is a notable source of essential amino acids, making it a valuable plant-based protein option for muscle recovery and repair.

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Its mineral content, including calcium, iron, and magnesium, contributes to bone health, oxygen transport, and muscle function, crucial factors for sportspersons' performance

On the other hand, cantaloupe (*Cucumis melo*), an amazing and refreshing melon, is well known for its high water content and great flavour. Beyond its flavour, cantaloupe is a fruit rich in nutrients, including vitamins A, C, and K, minerals like potassium and magnesium, phytochemicals, antioxidants, and important fat-soluble vitamins. These nutrients contribute to immune function, collagen synthesis, electrolyte balance, and muscle function, which are vital for sportspersons' performance and recovery (Sharma, Gujral, & Kaur, 2020; Yasmeen *et al.*, 2020) [23, 28]. This melon is a treasure trove of vital nutrients. Its high water content helps maintain hydration, a critical aspect for athletes engaged in intense physical activities. Furthermore, cantaloupe is abundant in vitamin A, known for its role in supporting vision and immune function, as well as vitamin C, a potent antioxidant that aids in collagen production and enhances recovery from exercise-induced oxidative stress. The presence of potassium in cantaloupe promotes proper muscle and nerve function, making it an ideal addition to a sportsperson's diet.

According to Coombes *et al.* (2018) [9], sports drinks are designed to replace fluids and electrolytes lost during exercise, promoting hydration and maintaining the right electrolyte balance. Sports beverages offer a source of carbohydrates like glucose and sucrose that the body can quickly absorb and use as an energy source during strenuous physical exercise, helping to maintain blood glucose levels and preventing exhaustion (Jentjens & Jeukendrup, 2003) [15]. By delivering fuel and preserving an ideal fluid balance throughout extended exercise, the carbohydrates and electrolytes found in sports drinks have been demonstrated to improve endurance performance and postpone tiredness (Jeukendrup, 2014) [16]. Carbohydrate-rich sports beverages can help keep the mind sharp throughout lengthy exercise, minimising mental exhaustion, and enhancing cognitive performance (Chambers *et al.*, 2009) [6]. Because they taste better than regular water, sports drinks help athletes stay hydrated while exercising. They are simple to access during practise and tournaments thanks to their accessible packaging and availability (Burke & Hawley, 2018) [5]. Research has begun to focus on the use of alternative grains, such as ragi (finger millet), which may be beneficial to stop the rising calcium deficit in people. A calcium-rich fast health beverage powder was created by Tripathi *et al.* (2014) [26] using malted and extruded ragi (*Eleusine coracana*), glucose, gurhal powder (*Hibiscus rosa-sinensis*), citric acid, and vanilla extract. The powder was dissolved and mixed in water before eating. The nutritional analysis of the instant health beverage powder also revealed that it included a high amount of calcium (96.5%) and protein (12.25%) in addition to having nutraceutical qualities. The study came to the conclusion that malted ragi can be utilised as a supplement for women who are deficient in calcium.

Combining finger millet and cantaloupe in a beverage presents an opportunity to create a nutritional solution tailored to the specific needs of sportspersons. This beverage could provide a diverse range of vitamins, minerals, antioxidants, and phytochemicals necessary for optimizing athletic performance, supporting muscle recovery, and maintaining overall health. Furthermore, the natural and whole food composition of this beverage aligns with the growing demand

for clean label and plant-based dietary options among sportspersons (Piya & Gaur, 2019) [20]. To accomplish these objectives, the following sections of this thesis will be covered: (1) a comprehensive review of existing literature on the nutritional properties and health benefits of finger millet and cantaloupe, (2) formulation and development of the finger millet and cantaloupe-based beverage, (3) evaluation of the beverage's nutritional composition through laboratory analysis. The combination of finger millet and cantaloupe in a beverage offers a synergistic effect, combining the nutritional benefits of both ingredients. By blending the two, it is possible to create a beverage that provides a wide range of vitamins, minerals, antioxidants, and phytochemicals, crucial for supporting optimal athletic performance and overall well-being.

Through the formulation and development of a finger millet and cantaloupe-based beverage, this study aims to bridge the gap between traditional whole foods and modern sports nutrition. By evaluating the beverage's nutritional composition and conducting controlled trials involving sportspersons, the study seeks to ascertain its potential impact on physical performance, endurance, and recovery. The findings from this research will contribute to the expanding field of sports nutrition, providing evidence-based insights into the effectiveness of this innovative beverage as a nutritional solution for sportspersons.

By understanding the potential advantages of this unique beverage and its impact on sportspersons' health and performance, this study aims to contribute to the field of sports nutrition, providing a novel and effective nutritional solution for athletes and sportspersons. In conclusion, the combination of finger millet and cantaloupe holds great promise as a natural and nutrient-dense beverage option for sportspersons. By harnessing the nutritional power of these ingredients, this thesis endeavors to provide a novel solution that promotes optimal health, performance, and recovery in athletes. Through a comprehensive review of existing literature, formulation and development of the beverage, as well as rigorous scientific evaluation, this study aims to shed light on the potential benefits of incorporating finger millet and cantaloupe-based beverages into the diets of sportspersons

Materials and Method

Purchasing and processing Ragi grains

Ragi (*Eleusine coracana*) has been bought in large quantities from the local market of Jalandhar. We also bought milk, cantaloupe, and honey from the local market in Jalandhar city. Under running water, ragi grains were extensively cleansed to get rid of dirt and other objects. After being spread out on a thin muslin cloth and tied loosely with the towel's edges, the clean grains were soaked in water at room temperature for an overnight period to allow them to germinate. Reintroduce the cloth into the 4myla and let it there for 48 hours at $28 \pm 1^\circ\text{C}$. A hot air oven was used to dry the germinated grains for 24 hours at $50 \pm 2^\circ\text{C}$. The developed malt was roasted in skillet at slow heat till the aroma developed and further ground in electric mixer to obtain fine flour. This whole flour was used in the development of malted ragi beverages.

Development of malted Ragi beverages

Ragi milk based beverages were developed using malted ragi powder in the food laboratory of Department of Food and

Nutrition, Faculty of Agriculture, Lovely Professional University, Punjab. Control samples were developed by using milk, cantaloupe and honey whereas experimental beverages were developed by incorporating malted ragi at different levels ranging from 5-15 percent

Recipe of the developed beverages by incorporating malted ragi powder:

Ingredients

Milk – 100 ml Fruit – 40 g Honey – 5 g Ragi – 5-15 g

Method

Cantaloupe was cleaned, skin was removed and was chopped into small pieces. In the next step, milk and chopped fruit were combined and blended properly with the help of blender. Honey was added and again mixture was blended. Strain the mixture to remove seeds of fruit (kiwi and strawberry).

Number of servings: 1 Volume per serving: 150 ml

Table 1: Cantaloupe beverage supplemented with malted ragi

Name of recipe	Ingredients	C	M1	M2	M3
	Milk	100 ml	100 ml	100 ml	100 ml
Mango Beverages	Cantaloupe	40 g	35 g	30 g	25 g
	Honey	5 g	5 g	5 g	5 g
	Ragi powder	-	5 g	10 g	15 g

Control©=Milk 100 ml with honey 5gms and Cantaloupe 40gms to make volume: 145 ml.

M1=Milk 100 ml with honey 5gms+Cantaloupe 35 gms + 5gms Malted ragi powder to make volume: 145 ml.

M2= Milk 100 ml with honey 5gms+Cantaloupe 30 gms + 10 gms Malted ragi powder to make volume: 145 ml

M3= Milk 100 ml with honey 5gms+Cantaloupe 25 gms + 15 gms Malted ragi powder to make volume: 145 ml

Result

Chemical composition of most acceptable malted ragi beverage: The cantaloupe beverage with 5% malted ragi was the most popular malted ragi beverage, and it conducted chemical analysis for proximate composition, amino acid content, mineral content, vitamin content, accessible carbs, and anti-nutritional components using standard techniques. The numbers were calculated for 100 gms of developed malted ragi beverage.

Sensory evaluation of developed beverages: Sensory evaluation of Cantaloupe malted ragi sports beverages is Table 2.

Organoleptic evaluation of Cantaloupe beverage supplemented with malted ragi

The cantaloupe beverage (M1) supplemented with 5% malted ragi had the highest mean scores, 8.1 overall acceptability, and was considered the most acceptable beverage by the panel of judges. Compared to this, the cantaloupe beverage (M3) supplemented with 15% malted ragi received the lowest mean scores and was considered the least acceptable. The lowest overall acceptability for (M3), or 6.9, was discovered. The Cantaloupe Ragi beverage added with 10% malted ragi (M2) had an overall acceptability score of 7.16, which was lower than the mean scores of (M1) for appearance, color, texture, 6mylas, and taste, which ranged from 7.6-8.2. The milk beverage made with corn flour, whey protein concentrate,

banana pulp, and sugar was studied by Kumar *et al.* (2017) [19], who found that the beverage made with 1% corn flour, 1% whey protein concentrate, 15% banana pulp, and 8% sugar was the most widely liked among the other beverages.

Sensory Evaluation of Cantaloupe beverage supplemented with malted ragi

After development, malted ragi sports beverages were offered for sensory evaluation. A panel of 5 judges experienced in the main sensory components of food products was used to assess the organoleptic properties of beverages. The panelists were tasked with rating the beverages on their general acceptability as well as their appearance, color, texture, and flavor. Every day, four samples - one control and three experimental samples - were offered in identical containers that were concurrently served and coded with various numbers. Each specimen was three times for each sample were used in the evaluation process. According to the evaluation used a 9-point hedonic rating scale. Liked extremely (8 points), liked very much (7 points), liked moderately (6 points), liked slightly (5 points), disliked slightly (4 points), disliked moderately (3 points), disliked very much (2 points), and disliked extremely (1 point) were the different ways that consumers expressed how much they liked or disliked a product. The testing was conducted in Food laboratory of Department of Food and Nutrition, Faculty of Agriculture, Lovely Professional University, Punjab.

Chemical Analysis Cantaloupe beverage supplemented with malted ragi

The sample with the highest acceptability grade was fully blended in a blender before it was separated into weighted portions for analysis. For four hours, it was dried in petri dishes in an oven set to 60 °C. For additional chemical analysis, the dried material was crushed to a fine powder and stored in airtight polythene bags. Standard techniques were used to assess the proximate composition of the crude protein, crude fat, crude fibre, ash, and minerals (AOAC 2000) [3]. Using a mixture of nitric acid and perchloric acid in a 5: 1 (v/v) ratio, samples were wet digested on a hot plate to determine the total amount of calcium, iron, zinc, and phosphorus using atomic absorption spectrophotometry (AOAC 2000) [3]. The sample beverage's amino acid content was assessed. The methods used by Horn *et al.* (1946) [14] and Concon (1975) [8] were 6mylase6 to estimate tryptophan and methionine, respectively. The Carpenter (1960) approach was used to estimate the amount of accessible lysine. Using a spectrophotometer-20, the spectrophotometric estimation of the available carbohydrate content included total sugars (Dubois *et al.* 1956) [10], reducing sugars (Nelson 1944), non-reducing sugars, and starch (Clegg 1956) [7]. Phytates and total phenols (mg/100 g) were determined using the methods developed by Haug and Lantzsch (1983) [13] and AOAC (1985) [2], respectively, to measure antinutritional components. The method described by Roy and Rao (1971) [21] was used to estimate the trypsin inhibitor activity.

Proximate Analysis (dry weight basis): The most acceptable malted ragi cantaloupe beverage was estimated to have 54.9 percent of moisture, 2.12 percent of ash, 5.2 g crude protein, 2.31 g of crude fat, 1.5 g of crude fibre, 20.6 g of carbohydrates and provided 197.85 Kcal of energy as shown in table 3. According to Swer *et al.* (2013) [25], pearl millet malt mixes containing papaya and banana had a moisture

content of 11% and 10%, 8.5- 8.45% protein, 3.9-5.4 percent fat, and 5.5-2.6 percent crude fibre, respectively, on a dry weight basis. Vasanthamani and Anuradha (2011) [27] created a pre-game sports drink with 5 g of sprouted ragi powder, roasted 7 mylas gm powder, green gm dhal powder, maize flour, 10 g of sago powder and sugar, 20 g of glucose, and 150 g of milk. They reported that the drink contained 317 kcal of energy, 8 g of protein, 62 g of carbohydrates, and 8 g of fat.

Minerals And Vitamins content (dry weight basis)

The most acceptable malted ragi cantaloupe beverage was estimated to have, 129.4 mg of calcium, 0.05 mg of iron, 93.2 mg of phosphorus and 0.386 mg of zinc, vitamin A: 4170 IU, vitamin C: 60 mg, potassium: 417 mg per 100 ml as shown in table 4. In a 2013 study, Kapoor *et al.* developed and examined a health drink using pearl millet, whey water, broccoli leaf powder, banana, and 7 mylase. They discovered that 100 mg of the manufactured drink included 2.96 mg of iron and 167 mg of calcium in terms of mineral content. 5.6 mg of ascorbic acid and 1568 g beta – carotene were present. According to Tripathi *et al.* (2012) [26], the bioaccessible zinc and iron concentrations of the double-fortified sorghum and ragi flours were 1.63 and 0.83 mg/100 g, respectively, and 2.63 and 2.39 mg/100 g, respectively.

Anti- nutritional components (dry weight basis): The most acceptable malted ragi cantaloupe beverage was estimated to have 115.6 mg of phytates, 12.1 mg of total phenols and 0.41 mg of trypsin inhibitor activity as shown in Table 5. According to Abu-Bakr *et al.* (2015) [1], the mineral composition of unprocessed finger millet (*Eleusinecoracana*) was Ca, K, Na, Mg, Zn, Fe, and Cr levels were respectively (174.58, 158.1, 24.372, 20.78, 0.533, 9.64, and 1.118 mg/100 g). B6, B3, B1, B2, and E each had levels of (167.7, 11.24, 332.24, 125.66, and 60.23 mg/100 g), respectively. According to Kapoor *et al.* (2013) [17], a drink made from pearl millet consisted of 18.2 mg of total phenols, 22.5 mg of oxalates, and 32.68 mg of phytin phosphorus.

Available Carbohydrates Content (dry weight basis)

The most acceptable malted ragi cantaloupe beverage was estimated to have total soluble sugars were found to be 4.59 g, 3.45 g of reducing sugars, 3.12 g of non-reducing sugars and 0.97 g of starch as shown in table 6. According to Shukla and Srivastava (2014) [24], noodles made with refined wheat flour had the highest concentrations of starch (63.02%), 7mylase (8.72%), and amyl pectin (54.29%), whereas noodles made with 50% finger millet had the highest concentrations of crude fat (1.15%), crude fibre (1.28%), carbohydrate (78.54%), insoluble dietary fibre (5.45%), and soluble dietary fibre (3.71%), respectively. Noodles made with finger millet flour were therefore discovered to be healthy and to have hypoglycemic effects.

Discussion

At a malted ragi supplementation of 5%, all the beverages made with cantaloupe and malted ragi were found to be satisfactory. The findings showed that, of all the beverages, the cantaloupe beverage containing 5% malted ragi was the most well-liked by the judging panel. Ganorkar and Jain (*et al.* 2014) [12] investigated the development of a ready-to-drink finger millet-based beverage. They assessed the sensory attributes, nutritional composition, and shelf-life stability of the formulated beverage, highlighting its potential as a

nutritious and convenient option for consumers.

Table 2: Organoleptic evaluation of Cantaloupe beverage supplemented with malted ragi

S.No	Appearance	Colour	Texture	Flavour	Taste	Overall
C	7.6±0.5	6.9±0.6	7.2±0.1	7.9±0.3	6.9±0.1	7.4±0.1
M1	7.9±0.1	7.3±0.8	7.8±1.2	8.3±0.1	7.4±0.5	8.1±0.4
M2	7.10±0.5	7.2±0.6	7.6±0.84	7.2±0.1	6.6±0.7	7.16±0.4
M3	6.8±1.05	7.1±0.5	7.3±0.68	7.0±0.82	5.9±1.2	6.94±0.81

Control©=Milk 100 ml with honey 5gms and Cantaloupe 40 gms to make volume: 145 ml.

M1=Milk 100ml with honey 5gms+Cantaloupe 35gms + 5gms Malted ragi powder to make volume: 145 ml.

M2= Milk 100ml with honey 5gms+Cantaloupe 30gms + 10 gms Malted ragi powder to make volume: 145 ml

M3= Milk 100ml with honey 5gms+Cantaloupe 25gms + 15 gms Malted ragi powder to make volume: 145 ml

Table 3: Proximate composition of malted ragi beverage per 100 ml (dry weight basis)

Proximate Analysis	Beverages
Moisture (%)	54.9±0.05
Ash (%)	2.12±0.04
Crude Protein (gm)	5.2±0.5
Crude Fibre (gm)	1.5±0.02
Crude Fat (gm)	2.31±0.91
Carbohydrates (gm)	20.6±1.5
Energy (Kcal)	197.85±5.25

Table 4: Vitamins and Mineral Content of malted ragi beverage per 100 ml (dry weight basis)

Vitamins & Minerals Content	Beverage
Calcium (mg)	129.4±0.9
Iron(mg)	0.05±0.01
Phosphorus(mg)	93.2±1.06
Zinc(mg)	0.386±0.01
Vitamin A(IU)	4170±105
Vitamin C(mg)	60±1.15
Potassium(mg)	417±5.2

Table 5: Anti- nutritional components of malted ragi beverage per 100 ml

Anti-Nutritional Factor	Beverage
Phytates (mg)	115.6±0.09
Total Phenol (mg)	12.1±0.05
Trypsin Inhibitor (mg)	0.41±0.01

Table 6: Available carbohydrate content of malted ragi beverage per 100 ml (dry weight basis)

Carbohydrates Content	Beverage
Total Soluble Sugar (gm)	4.59±0.06
Reducing Sugar(gm)	3.45±0.15
Non Reducing Sugar (gm)	3.12±0.8
Starch (gm)	0.97±0.01

Conclusion

All the samples of beverages that was developed, it is concluded that beverage consisting 5 percent malted ragi was most appropriate and accepted by the panel of judges. On the basis of analysis and results, it can be considered as a good energy drink for sportsperson as it can provide all the

essential nutrition to them. Based on the findings, it can be deduced that supplemental beverages containing 5% of malted ragi can be developed successfully with high nutritional value and without having a negative effect on sensory attributes, which can improve calcium levels and hydration in sportspeople.

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