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Sensory and nutritional evaluation of developed functional beverage using underutilized foods

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Underutilized plants are species with under-exploited potential for contributing to food security and nutrition by combating 'hidden hunger' caused by micronutrient deficiencies. The present study was carried out to develop a functional beverage from underutilized foods. Functional beverage was prepared by using whey water, pearl millet, cauliflower leaf powder, banana and jaggery at three different levels *i.e.* S_1, S_2 and S_3. The developed functional beverage was organoleptically evaluated by a panel of judges and students by using nine-point hedonic scale. Both the panels gave the highest overall acceptability scores to the S_1 level which was prepared by using 2.5g cauliflower (*Brassica oleracea* var. botrytis) leaf powder, 5 g pearl millet (*Pennisetum typhoideum*), 10g jaggery, 20g banana and 63ml whey water per 100ml. The most acceptable level of developed functional was analyzed for proximate composition which showed that it had 81g of moisture, 2.8 g of crude protein, 0.4g of crude fat, 0.9g of crude fibre, 0.85g of ash, 14.05g of carbohydrates and provided 71 Kcal of energy. Developed functional beverage had 11.8g total soluble sugars, 4.55g of reducing sugars and 7.25g of non-reducing sugars. The concentration of minerals iron and calcium in functional beverage was 5.51mg and 103mg, respectively. The concentration of vitamins, ascorbic acid and β-carotene was 2.7 mg and 1185 µg/100ml, respectively.

Key Words : Hinden hunger, Cauliflower (*Brassica oleracea* var. Botrytis), Pearl millet (*Pennisetum typhoideum*), Whey water, Functional beverage

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INTRODUCTION

Many underutilized species are nutritionally rich and adapted to low input agriculture. Underutilized species offer untapped potentials to contribute to fight malnutrition. Their enhanced use can bring about better nutrition. Emphasis should thus be given to those species having comparative advantages in providing better food, being affordable by the poor and more available both in time and space.

In India, the consumption of green leafy vegetables is very low and is much below the recommended dietary allowances. Therefore, majority of Indians don't meet sufficient vitamins and minerals present in leafy vegetables. Cauliflower (*Brassica oleracea* var. Botrytis) bears extensive leaves which are removed and discarded prior to cooking. The proportion of cauliflower and leaves arriving in the market is 2:1 of which the discarded leaves contribute to approximately 50 per cent of total production of cauliflower and dehydrated greens are considered concentrated sources of nutrients, addition of small amounts of these foods in various dietary preparations could be of immense value to combat the global prevalence of micronutrient malnutrition (Kowsalaya and Vidhaya, 2004).

Whey is a nutritious by-product from cheese, chhana and paneer containing valuable nutrients like lactose, proteins, minerals and vitamins etc., which have indispensable value as human food. It is estimated that about 100 million kg of whey is annually derived as a by- product which may cause substantial loss of about 70,000 tonnes of nutritious whey solids. In addition, it is adding biological oxygen demand (BOD) load to effluent (approx 35,000 to 45,000 mg / l) (Parekh, 2006).

In India, Pearl millet (*Pennisetum typhoideum*) is the fourth most important staple food crop after rice, wheat, and sorghum. The grain of pearl millet is particularly rich in iron and zinc and

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has high levels of fat and considered to have one of the best protein quality or amino acid score as compared to other cereals.

Bananas (*Musa paradisiaca*) are power house of nutrients. They are great sources of an array of nutrients, with B-complex vitamins, vitamin C, potassium, manganese and magnesium (Cheamsawat, 2003). Bananas are an exceptionally rich source of fructooligosaccharide, a compound called a prebiotic because it nourishes probiotic bacteria in the colon. These beneficial bacteria produce vitamins and digestive enzymes that improve our ability to absorb nutrients, plus compounds that protect us against unfriendly microorganisms.

Jaggery (*Saccherum officinarum*) is a traditional unrefined non-centrifugal whole cane sugar consumed in Asia, Africa, Latin America, and the Caribbean. It is a concentrated product of cane juice without separation of the molasses and crystals. It contains up to 50 per cent sucrose, up to 20 per cent invert sugars, moisture content of up to 20 per cent, and the remainder made up of other insoluble matter such as wood ash, proteins and bagasse fibers. Jaggery drinks are taken to maintain a balance in blood sugar and to provide instant source of energy. Keeping in view the importance these underutilized foods, the present study was planned to develop a functional beverage with optimum nutritional and sensory attributes.

METHODOLOGY

Procurement of raw materials :

Pearl millet and jaggery was obtained in a single lot whereas whey water and bananas were procured on daily basis from the local market of Ludhiana. Cauliflower leaves were procured in 5 lots from the vegetable farm of PAU, Ludhiana.

Preparation of cauliflower leaf powder:

The leaves were washed, blanched in boiling distilled water for 10-15 sec and dried at room temperature for 1-2 hr by spreading on filter paper followed by drying in hot air oven at 50 ± 5^0 C for 48+6 hrs. The dried leaves were grounded to fine powder.

Malting of pearl millet:

Pearl millet grains were cleaned, steped in water for 12 hours, germinated for 36 hours at room temperature (27^0C) and dried in hot air oven at 60^0C for 8 hrs and then seedlings were removed by hand rubbing to prepare malt (Malleshi and Desikachar, 1981). The malt was roasted in skillet at slow heat till the aroma developed, ground in electric mixer to obtain fine flour. This whole flour was used for the development of functional beverage.

Development of functional beverage:

The functional beverage was prepared in the Food Laboratory of Department of Food and Nutrition, College of Home Science by using whey water, pearl millet, cauliflower leaf powder, banana and jaggery at three different levels *i.e.* S_1, S_2 and S_3. The first level was prepared by using 2.5 g cauliflower leaf powder, 5 g pearl millet, 10 g jaggery, 20 g banana and 63 ml whey, second level (S_2) was prepared by using 3 g cauliflower leaf powder and all the ingredients in the same proportion as in S_1 level and third level (S_3) was prepared by using 3.5 g cauliflower leaf powder and using rest ingredients in the same proportion as in S_1 level.

Organoleptic evaluation of developed functional beverage:

The organoleptic evaluation of developed functional beverage was done by the panel of judges including faculty of Department of Food and Nutrition and few students. They were provided with score card of hedonic rating scale to score the test samples to select the most acceptable level of the developed functional beverage for their colour, appearance, flavour, texture feel, taste and overall acceptability.

Chemical analysis of developed functional beverage:

The most acceptable level were chemically analyzed for proximate composition (AOAC, 1990), total soluble sugars (Dubois *et al.*, 1956), reducing sugars (Nelson, 1944), non reducing sugars (by calculation), iron (AOAC, 2000), calcium (AOAC, 1980), ascorbic acid (AOVC, 1996) and beta-carotene (Rao, 1967).

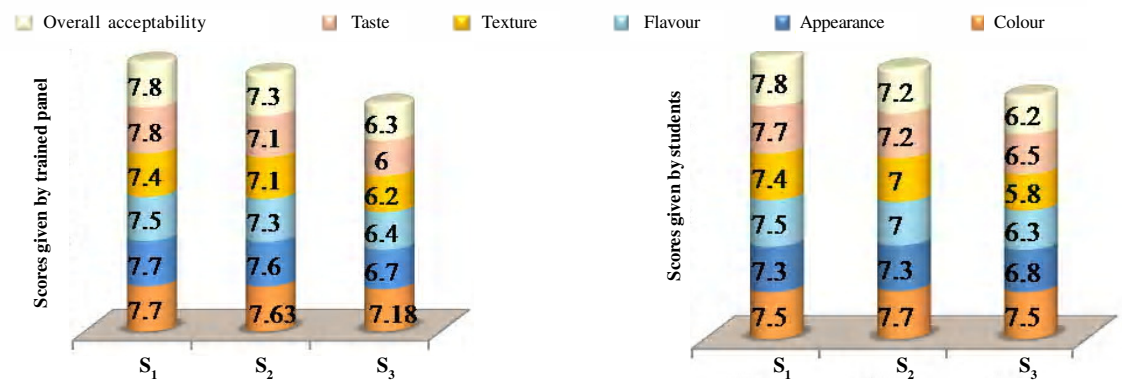
Statistical analysis:

Statistical analysis of the data was carried out as per Cheema and Singh (1990) using a computer programme package.

OBSERVATIONS AND ASSESSMENT

Three different levels of functional beverage *i.e.* S_1, S_2 and S_3 were developed using cauliflower leaf powder, pearl millet, jaggery, banana and whey water. The developed functional beverage was organoleptically evaluated by a panel of judges from the department of food and nutrition and students by using nine-point hedonic scale to judge the acceptability of the product and the scores given by the trained panel for colour, appearance, flavour, texture, taste as well as overall acceptability of the developed functional beverage varied from 7.18 to 7.7, 6.7 to 7.70, 6.4 to 7.5, 6.2 to 7.4, 6 to 7.8 and 6.3 to 7.8, respectively. The corresponding scores given by the student's panel varied from 7.5 to 7.7, 6.8 to 7.3, 6.3 to 7.5, 5.8 to 7.4, 6.5 to 7.7 and 6.2 to 7.8, respectively. According to the both panels the most acceptable level of beverage was S_1, which was having 2.5 g cauliflower leaf powder, 5 g pearl millet, 10 g jaggery, 20 g banana and 63 ml whey. It had the overall acceptability score of 7.8+0.78 (Fig. 1).

Hundred grams of developed functional analyzed for proximate composition showed that it had 81 g of moisture, 2.8 g of crude protein, 0.4 g of crude fat, 0.9 g of crude fibre, 0.85 g of ash, 14.05 g of carbohydrates and provided 71 Kcal of energy.



S_1= functional beverage with 2.5 g cauliflower leaf powder, 5 g pearl millet, 10 g jaggery, 20 g banana and rest whey water to raise the volume to 100ml
S_2= functional beverage with 3 g cauliflower leaf powder and rest ingredients same as in S1
S_3= functional beverage with 3.5 g cauliflower leaf powder and rest ingredients same as in S1
Values are Mean

Fig 1. Organoleptic evaluation of developed functional beverage

Developed functional beverage had 11.8 g total soluble sugars, 4.55 g of reducing sugars and 7.25 g of non-reducing sugars. The concentration of minerals like iron and calcium in functional beverage was 5.51 mg and 103 mg, respectively. The concentration of vitamins like ascorbic acid and β-carotene was 2.7 mg and 1185 µg, respectively (Table 1).

Table 1. Nutritional composition of developed functional beverage (Fresh weight/100 ml)

Proximate composition	FW (g/100 ml)
Moisture	81
Crude protein	2.8
Crude fat	0.4
Crude fibre	0.9
Ash	0.85
NFE	14.05
Energy (Kcal)	71
Available carbohydrates:	(g/100ml)
Total soluble sugars	11.8
Reducing sugars	4.55
Non reducing sugars	7.25
Minerals and vitamins:	(mg/100ml)
Iron	5.51
Calcium	103
Vitamin C	2.7
β-carotene (µg/100 ml)	1185

A nutritional comparison was done between the developed functional beverage and carbonated drinks available in the market which showed that functional beverage was the good source of energy, protein, carbohydrates, iron, vitamin C and β-carotene, also it was cost effective than the carbonated drinks. (Table 2).

Table 2. Comparison of developed functional beverage with carbonated drink

Nutritional information per 100 ml	Functional beverage	Carbonated drink
Energy (Kcals)	71	44
Protein (g)	2.8	0
Carbohydrates (g)	14.05	11
Iron (mg)	5.51	0
Calcium (mg)	103	0
Beta-carotene (µg)	1185	0
Cost: (Rs.)	2.7	5

Conclusions:

A functional beverage with optimum nutritional and sensory attributes was developed using underutilized foods like 2.5 g cauliflower leaf powder, 5 g pearl millet, 10 g jaggery, 20 g banana and rest using whey to raise volume 100ml which can be very well incorporated to diets of people in order improve their nutritional status.

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