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Sensory and nutritional evaluation of health drink for adolescent girls using underutilized foods

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A health drink was prepared by using whey water, pearl millet, broccoli leaf powder, banana and jaggery at three different levels *i.e.* S_1 with 5g pearl millet, 2.5g broccoli leaf powder, 50g banana, 10g jaggery and 82.5 ml whey water, S_2 with 5g pearl millet, 3g broccoli leaf powder, 50g banana, 10g jaggery and 82.5 ml whey water and S_3 with 5g pearl millet, 3.5g broccoli leaf powder, 50g banana, 10g jaggery and 82.5ml whey water. The developed health drink 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. The most acceptable level was chemically analyzed for proximate composition, available carbohydrates, vitamins and minerals and anti nutritional factors by using standard methods. Hundred milligram of developed drink was analyzed for proximate composition showed that it had 61.43g of moisture, 2.9g of crude protein, 0.4g of crude fat, 1.2g of crude fibre, 2.2g of ash, 31.87g of carbohydrates and provided 142.68 Kcal of energy. Developed health drink had 21.7g total soluble sugars, 7.9g of reducing sugars, 13.8g of non-reducing sugars and 9.8g of starch. The concentration of minerals iron and calcium in the drink was 2.96 mg and 167 mg, respectively. The concentration of vitamins, ascorbic acid and β-carotene was 5.6 mg and 1568 µg, respectively. The amount of total phenols, oxalates and phytin phosphorus in the drink was 18.2 mg, 22.5 mg and 32.68 mg, respectively.

Key Words : Adolescent girls, Banana, Broccoli leaves, Health drink, Jaggery, Pearl millet, Whey water

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INTRODUCTION

Adolescent girls are particularly vulnerable to malnutrition because physical changes affect the body's nutritional needs and any nutritional deficiency experienced during this critical period of life can have an effect on the future health of the individual and their offspring as adolescent girls are the "future mothers". They need protein, iron, and other micronutrients to support the adolescent growth spurt and meet the body's increased demand for iron during menstruation. Moreover, these girls go through a peak period of dietary changes, from self-imposed dietary restrictions, leading to poor nutrition and health status. During adolescence nutrient intake of iron, calcium, zinc, vitamin A and vitamin C are often lower than the required amounts. (Ransom and Elder, 2011).

Food based strategy is used as a tool for combating micronutrient deficiencies. It is also referred as dietary modification, which encompasses a wide variety of intervention that aim at increasing the production, availability and consumption of food products, which are rich in micronutrients (Joshi and Mehta 2010). Many underutilized foods, whey water, pearl millet and broccoli leaves which are available at low cost can be used to improve the nutritional status of the adolescent girls. The present study was carried out to develop a health drink from underutilized foods.

The health drink under this study was developed by using underutilizes food ingredients like pearl millet, whey water, broccoli leaf powder, banana and jaggery.

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Bajra (pearl millet) is a staple food of rural people of dry land regions of India but now a days coarse cereals and millets are gaining popularity because of their high nutritive value. Bhatnagar and Goyal (2000) reported 3.90 mg of zinc, 11.60 mg of sodium, 309.70 mg of potassium and 8.90 mg of iron/ 100g of pearl millet and also showed that vitamin C was completely absent in ungerminated and ungerminated roasted grains while germinated grain had 3.50 mg/100g of vitamin C. Sehgal and Kwatra (2006) stated in their study on value added food products from millets which are nutritionally superior to major cereal with respect to proteins (ranging from 7.02-13.67%), energy, vitamins and minerals. They are rich source of dietary fibre, phytochemicals, micronutrients etc. realizing the nutritional composition the pearl millet is considered as "NUTRI-CEREAL". Ummu and Shreenithee (2009) developed a healthy drink using bajra 200 g, roasted gram 30 g, ground nut 20 g and 10 g of cashew nut, and filtered jaggery water and found that two cups per day when consumed by youth and working people, it helped them to be active for whole day and also found drink to be cost effective.

Several traditional household food-processing and preparation methods can be used to enhance the bioavailability of micronutrients in plant-based diets. These include thermal processing, mechanical processing, soaking, fermentation, and germination/malting. These strategies aim to increase the physicochemical accessibility of micronutrients, decrease the content of anti-nutrients, such as phytate, or increase the content of compounds that improve bioavailability. A combination of strategies is probably required to ensure a positive and significant effect on micronutrient adequacy.

Jooyandesh (2007) reported the composition of whey as total solids 6.48 per cent, 6.04 pH, acidity 13.95^{0}D, protein 0.91 per cent, fat 0.15 per cent, ash 0.52 per cent and carbohydrates 4.72 per cent. Vidya *et al.* (2009) investigated the average composition of whey and found that it contains moisture 93.42 per cent, fat 0.42 per cent, protein 0.44 per cent, lactose 5.12 per cent, ash 0.60 per cent, non-solid fat 6.16 per cent and total solids 6.58 per cent, respectively. Burrington (2004) reported that the biological value for whey protein is 104 versus 88-100 for eggs, 74 for soy protein, and 54 for wheat and these proteins provide approximately 26 g of the branched chain amino acids leucine, isoleucine and valine per 100 g of protein.

In a study by Swarnalatha and Yegammai (2006) reported that green leaves are valuable source of high quality protein, vitamins and minerals. Supplementation of iron with absorption enhancers namely vitamin C and A to the adolescent girls resulted in better iron nutriture when compared to the girls who were supplemented with iron alone. USDA (2011) report indicated the nutritional value of broccoli leaves as calories 28 kcal, protein 3 g, calcium 48 g, iron 0.88 mg, vitamin A 16000 IU, vitamin C 93.2 mg. They also reported that this food is low in saturated fat, and very low in cholesterol. It is also a good source of protein, thiamin, niacin, pantothenic acid, calcium, iron and selenium, and a very good source of vitamin A, vitamin C, riboflavin, vitamin B_6, folate, magnesium, phosphorus, potassium and manganese.

Gopalan *et al.* (2007) found that banana contains 70.1 g moisture, 1.2 g protein, 0.3 g fat, 0.8 g minerals, 0.4 g crude fibre, 27.2 g carbohydrates, 116 kcal energy, 17 mg calcium, 36 mg phosphorus and 0.36 mg iron per 100 g. A report by USDA (2010) stated that 100 g of banana contains 89 kcal energy, 22.84 g carbohydrates, 12.23 g sugars, 2.6 g dietary fibre, 0.33 g fat, 1.09 g protein, 64 IU vitamin A, 0.031 mg thiamine, 20 µg folate, 8.7 mg vitamin C, 5 mg calcium, 0.26 mg iron and 358 mg potassium.

Singh (1998) jaggery is a wholesome diet and it contains 0.6 -1.0 per cent minerals, important among them are iron (11%), calcium (0.4 %), magnesium and phosphorus (0.045%). Jaggery also contains reducing sugars including glucose and fructose (10-15%), protein (0.25%) and fat (0.05%).

Objective of the study:

To develop a health drink using underutilized foods with optimum nutritional and sensory attributes.

METHODOLOGY

Procurement and processing of the raw material:

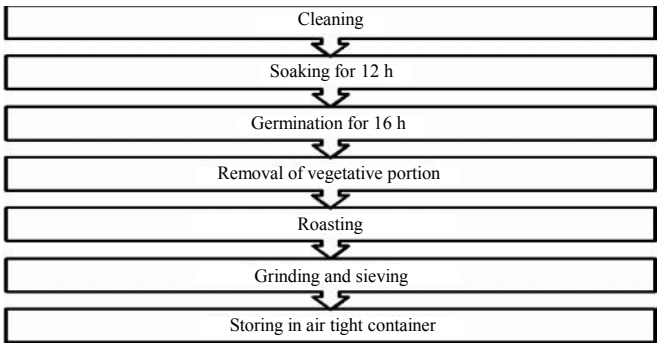
Broccoli leaves were procured by contacting the local vegetable grower. Whey water was procured on daily basis from the local dairy shop. Pearl millet, bananas and jaggery were obtained from the local market of Ludhiana.

Preparation of broccoli leaf powder:

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

Malting of pearl millet:

Pearl millet grains were cleaned, soaked 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 hours 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 (5 min for 100 g of grain), ground in electric mixer to obtain fine flour. This whole flour was used for the development of health drink.

Development and standardization of health drink:

The health drink was prepared in the Food Laboratory of Department of Food and Nutrition, College of Home Science by using whey water, pearl millet, broccoli leaf powder, banana and jaggery at three different levels *i.e.* S_1, S_2, and S_3.

S_1: 5 g pearl millet, 2.5 g broccoli leaf powder, 50 g banana, 10 g jaggery and 82.5 ml whey water was added to make it 150 ml.

S_2: 5 g pearl millet, 3 g broccoli leaf powder, 50 g banana, 10 g jaggery, and 82.5 ml whey water was added to make it 150 ml.

S_3: 5 g pearl millet, 3.5 g broccoli leaf powder, 50 g banana, 10 g jaggery and 82.5 ml whey water was added to make it 150 ml.

Organoleptic evaluation of developed health drink:

The organoleptic evaluation was done to select the most acceptable level of ingredients used in the development of health drink. The panel of judges including faculty of Department of Food and Nutrition and students were provided with score card of hedonic rating scale to score the test samples for their color, flavor, texture, taste and overall acceptability. The drink was prepared and for sensory parameters twice. Mean scores and standard error were calculated after the second trial.

Chemical analysis of developed functional beverage:

The most acceptable level was analyzed chemically for the following:

- Proximate composition (AOAC, 1980).
- Total soluble sugars (Dubois *et al.,* 1956).
- Reducing sugars (Nelson 1944) and non-reducing sugars (by calculation).
- Mineral content: Iron (AOAC, 2000) and calcium (AOAC, 1980).
- Vitamin content: β-carotene (Rao, 1967) and vitamin – C (AOVC, 1996)
- Anti-nutritional factors: Phytin Phosphorous (Haung and Lantzsch, 1983), Total Phenols (AOAC, 2000) and Oxalate (Abeza *et al.,* 1968)

OBSERVATIONS AND ASSESSMENT

The result of the undertaken study has been discussed under the following headings:

Organoleptic evalution of the developed health drink:

The data of organoleptic evaluation has been presented in Table 1.Three different levels of health drink were prepared using broccoli leaf powder, pearl millet, jaggery, banana and whey water. The developed health drink 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.

The scores given by the trained panel for colour, flavor, texture, taste as well as overall acceptability of the developed health drink varied from 7 to 7.4, 6.5 to 7.6, 6.6 to 7.4, 6.3 to 7.5 and 6.5 to 7.7, respectively (Table 1). According to the trained panel the most acceptable level of drink was having 2.5 g broccoli leaf powder, 5 g pearl millet, 10 g jaggery, 50 g banana and 82.5 ml whey. It had the overall acceptability score of 7.7 ± 0.18.

According to the scores given by the student's panel, the scores for colour, flavour, texture, taste as well as overall acceptability of the developed health drink varied from 5.9 to 7.2, 6 to 7.8, 5.9 to 7.4, 5.8 to 7.9 and 5.8 to 7.8, respectively. The overall acceptability was highest for the same recipe *i.e.* S_1 level with acceptability score as 7.8 ± 0.17. Both the panels gave the highest overall acceptability scores to the drink with 2.5 g broccoli leaf powder, 5 g pearl millet, 10 g jaggery, 50 g banana and 82.5 ml whey water.

According to trained panel a non-significant difference was observed in colour and texture of the three levels.

Nutritional evaluation of the development health drink:

The developed health drink was analyzed chemically for proximate composition, available carbohydrates, mineral content, vitamin content and anti-nutritional factors by using standard methods. The values have been calculated for 100 ml of health drink.

Proximate composition of developed health drink:

Developed health drink had 61.43 g of moisture, 2.9 g of crude protein, 0.4 g crude fat, 1.2 g crude fibre, 2.2 g ash, 31.87 g carbohydrates and provided 142.68 Kcal of energy (Table 2).

Available carbohydrates:

Developed health drink had 21.7 g of total sugars, 7.9 g of reducing sugars, 13.8g of non-reducing sugars and 9.8 g starch (Table 3).

Mineral and vitamin content:

The concentration of iron and calcium in developed health drink was 2.96 mg and 167 mg, respectively. The concentration of vitamins in developed health drink was 5.6 mg of vitamin C and 1568 µg of β-carotene (Table 4).

Table 1. Organoleptic evaluation of developed health drink

Sr. No.	Colour	Flavour	Texture	Taste	Overall acceptability
Trained panel					
S_1	7.4±0.22	7.6±0.21	7.4±0.18	7.5±0.1	7.7±0.18
S_2	7.2±0.29	7.0±0.31	6.8±0.36	6.7±0.33	6.9±0.29
S_3	7.0±0.24	6.5±0.26	6.6±0.26	6.3±0.26	6.5±0.26
F ratio	0.56^{NS}	3.64*	2.08^{NS}	4.73*	5.30*
C.D.	_	0.77	_	0.79	0.71
Students panel					
S_1	7.2±0.2	7.8±0.18	7.4±0.2	7.9±0.19	7.8±0.17
S_2	6.2±0.36	6.8±0.27	6.6±0.34	6.6±0.28	6.6±0.26
S_3	5.9±0.35	6.0±0.27	5.9±0.34	5.8±0.35	5.8±0.31
F Ratio	4.61*	13.92*	5.75*	13.54*	16.67*
C.D.	0.89	0.70	0.87	0.82	0.73

S_1 = Health drink with 2.5 g broccoli leaf powder, 5 g pearl millet, 10 g jaggery and 50 g banana and 82.5 ml whey water to make the volume 150 ml.
S_2 = Health drink with 3 g broccoli leaf powder, 5 g pearl millet, 10 g jaggery and 50 g banana and 82.5 ml whey water to make the volume 150 ml.
S_3 = Health drink with 3.5 g broccoli leaf powder, 5 g pearl millet, 10 g jaggery and 50 g banana and 82.5 ml whey water to make the volume 150 ml.
Values are mean± S.E. *indicates significance of value at P=0.05 NS- Non-significant

Table 2. Proximate composition of developed health drink

Proximate composition	(g/100ml)
Moisture	61.43
Crude protein	2.9
Crude fat	0.4
Crude fibre	1.2
Ash	2.2
NFE	31.87
Energy (Kcal)	142.68

Table 3. Available carbohydrates in developed health drink

Available carbohydrates	(g/100ml)
Total soluble sugars	21.7
Reducing sugars	7.9
Non reducing sugar	13.8
Starch	9.8

Table 4. Mineral and vitamin content of developed health drink

Minerals and vitamins	(mg/100ml)
Iron	2.96
Calcium	167
Vitamin C	5.6
β-carotene (µg/100ml)	1568

Table 5. Anti-nutritional factors of developed health drink

Anti-nutritional factors	(mg/100ml)
Phytin Phosphorus	32.68
Total phenols	18.2
Oxalates	22.5

Anti-nutritional factors:

Developed health drink had 32.68 mg of phytin phosphorus and 18.2 mg of total phenols and 22.5 mg of oxalates (Table 5).

Conclusion:

Considering nutritional importance of whey water, pearl millet, broccoli leaf powder, banana and jaggery which has not been widely used as food, this is an attempt to try their efficiency in improving nutritional status of adolescent girls. Health drink was prepared by using whey water, pearl millet, broccoli leaf powder, banana and jaggery at three different levels *i.e.* S_1, S_2 and S_3. The S_1 level was prepared by using 5 g pearl millet, 2.5 g broccoli leaf powder, 50 g banana, 10 g jaggery, and 82.5 ml whey was added to make it 150 ml whereas in S_2 and S_3 level, the amount of broccoli leaf powder was increased to 3 ad 3.5 g, respectively. The organoleptic evaluation of developed drink was done by a trained panel of ten judges and students panel using nine-point hedonic rating scale. According to the both panels the most acceptable level was S_1.The investigation of present study revealed that intake of cereals, pulses, roots and tubers, other vegetables, green leafy vegetables, fruits and sugar/jaggery by the adolescent girls, was significantly lower than the suggested value. The diets of adolescent girls were deficient in major nutrients. The mean daily intake of vitamins and minerals was also less than the recommended values.

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