Protein and Calcium Rich Malted Health Drink Power

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Abstract

A health drink powder has been developed from malted finger millet (Eleusine coracana), various combinations of pulses and skim milk powder. Compare to other health drinks available in market, it has very high content of protein (25.01%) and calcium (Ca-1018.7 mg/100 g). The nutritional content was sufficient to meet day to day nutritional requirements as a supplement. Result of sensory analysis data showed that it has higher acceptability among people and also it is a cost effective product.

Keywords: Pulse (legumes); Skim milk powder; Malting; Hunter colour-lab

Introduction

The plant foods are considered vital to our survival and nearly 70% of food proteins and more than 80% of food energy requirements are supplied by the plants and cereal grains are in the majority to fulfill these requirements [1]. In third-world countries, a requirement of high nutrient foods is for lactating women, hard-working people and pre-school children are the biggest challenge of the current time and to make available them in the market at economical price and also in the most acceptable form.

The daily calcium requirement for adults is 800-1200 mg. It has been found that sufficient quantity of calcium intake protects against osteoporosis, colon cancer and kidney stone and also helps to control blood-lipid levels. The optimum ratio of calcium to protein is necessary for bone gain in children. Normally, 16.1 (mgg) is good for human health [2]. Protein-energy malnutrition is a common syndrome in India which occurs during the weaning phase of a child’s life [3] and also in the case of pregnant and the lactating women. Furthermore, diabetes is a major disorder that increases among different age groups and in India it was 19 million in the year 1995 which increased to 25 million in 2007 and by 2025 it would reach up to 57 million [4]. Cereals are prime targets in this regard. As dietary staples, relatively small improvements in grain composition (especially in starch and fibre) have the potential to translate into significant health gains at the population level when they are incorporated into food [5]. Millets are one of such kind of the cereal. Millet is a cereal crop plant belonging to the grass family, Graminaceae [6]. They are an old food known to human and possibly the first cereal grain to be used for domestic purpose. In Indian civilization, it is also mentioned in brihad sanhita. Millets are highly nutritious, non-glutinous, non-acid forming, least allergenic and most digestible available grains. Hence, it is also called as "nutri-cereals". Various types of millets are cultivated in the world. Among these, finger millet (Eleusine coracana) is the most widely grown millet in India. Finger millet is originally native to Ethiopian highlands and was introduced in India 4000 years ago [7]. In year 2007, production of finger millet round the world is 4.5 million tons in which only India accounts for 10,610,000 tons [8]. It contains 7.7% protein, 1.5% fat, 2.6% minerals, 3.6% fibre, 72.6% carbohydrate and its 100g of seeds contains 350 mg of calcium, 283 mg of phosphorus, 3.9 mg of iron, 0.19 mg of riboflavin, 1.1 mg of niacin and 0.42 mg of thiamin [9]. Some of the known health benefits associated with the finger millet, such as its hypoglycemic [10], hypo-cholesterolemic characteristics [11], anti-ulcerative properties and anti-microbial properties [12] along with above therapeutic values it has also longer storage quality [13].

Finger millet malt was highly acceptable sensory profile among all the millets [14,15] and also malting further increases its protein utilization and calcium content [16]. Pulses are the major source of protein of the human dietary system. Pulses and cereals constitute an important source of dietary calories and proteins for much of the world’s population, especially in developing countries. Domestic processing, such as malting and roasting, has been shown to reduce the levels of phytic acid [17,18], saponins [19] and polyphenols [20] in legumes and due to reduction of anti-nutritional factors, the total nutrition utilization of the legumes in the human body is increases. Milk and milk products are the good source of protein, fat, lactose and essential minerals including calcium. The combination of lysine-rich milk protein with lysine deficient cereals delivers the synergistic effect, which imparts a high nutritional value to the mixed protein in the products [21] and also milk & milk products enhance the sensory profile of foods which leads to increase its the acceptability among consumers.

To develop a product that can be able to meet the daily requirements of nutrition by supplementation as well as beneficial for excellent health is requirement of current era. Therefore, developing a health drink powder based on finger millet, milk and pulses to fulfill above discussed requirements for human health will be very good option. Such a formulation which could be stored for longer time as well as used even in those areas where the liquid milk is not easily available.

The study was conducted with the following objectives:

1. To develop protein and calcium rich malted health drink powder (PCMHDP).

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2. To evaluate the PCMHDP in terms of chemical composition and sensory profile.
3. To calculate techno-economical feasibility PCMHDP.

**Materials and Methods**

Raw materials which were used for development of PCMHDP were good quality of Finger millet, skim milk powder (SMP), pulses, emulsifier and stabilizer were purchased from the local market of Raipur, India.

**Preparation of finger millet based malt powder (FMMP)**

In order to develop PCMHDP, finger millet was mixed with the pulses. Due to this combination, the protein content had been increased by several folds. Finger millet was mixed with two different types of pulses at a time to obtain a synergetic effect. Various types of combinations were made to figure out best one in terms of both sensory and nutritional aspects (Figure 1). The best suitable combinations according to requirement were made and showed in tables 1 and 2.

![Materials and methods flow-diagram of development of PCMHDP](image)

**Table 1: Combinations of FMMPs.**
Results

The chemical composition of the Skim Milk Powder (SMP) and FMMPs were determined to keep observation on the quality of raw materials so that best possible quality of standard PCMHDPs could be prepared. The proximate analysis results of FMMPs were shown in table 3.

FMMPs were mixed with the double toned milk (DTM) at room temperature and a constant amount of sugar, which was @ 6% was added after that it was boiled on medium flame to prepare 3 different concentrations of malt beverages from each type of FMMPs. The different blends of finger millet based malt powders and DTM, which were used to prepare malt beverages were 5:95, 10:90 and 15:85 (FMMP : DTM), they were represented as T1, T2, and T3 respectively. The selection of the most acceptable malt beverage was done based on the sensory analysis result which was based on the scores of 7 expert judges with help of 9-point “Hedonic scale”. On the basis of sensory test results, it was found that the T2 was the most acceptable combination. The average sensory score card of the T2 was given below in the table 4.

An attempt was done in present investigation to develop a standard product by using FMMP and skim milk powder. By the reverse calculation method, the optimum amount of FMMP and milk solids was calculated for the most acceptable blend of malt beverage. In order to develop PCMHDP, 100g FMMP; 95.5 g of SMP, Luke warm water @ 50%, Stabilizer @ 0.5% and emulsifier @ 0.5% were taken before drying. The drying was done as the process suggested by Song-Bodenstab and Paul [22] with few modifications in order to improve the solubility and sensory profile of PCMHDPs. The chemical composition of finally developed PCMHDPs was shown in table 5.

On the basis of sensory score card given by the panel of 7 judges on “9-point Hedonic Scale” the most acceptable composition of PCMHDP was selected. The sensory score data was given in figure 2.

The solubility of the finally developed and selected PCMHDP was analyzed by the method described in the F.A.O. manuals of Food Quality Control 14/ 8 page 31/ British standard 1743: Part 2 : 1980. The averages values of solubility of different powders were given in the table 6.

Colour analysis of selected PCMHDP

The variation in colour from one product to another is a natural phenomenon. The colour of the product was measured by the “Hunter-lab”’. The Hunter colour scale (L, a and b) evolved during the 1950s and 1960s. At that time many of the scientists involved with colour measurement were working with colour scales that took quite a lot of effort and understanding to interpret but these scales did not visually relate to what the human saw and made it difficult for organizations to set a standard to work to.

Mr. Richard Hunter invented the L, a, b colour scale that took the theory that we don’t just “see” colour but we can also talk about how light or dark the object is.

For better representation of colour measurement is shown in terms of L, a and b values while the total Hunter lab colour was represented as E (Where, E = (√(L^2 + (a)^2 + (b)^2)^2).

+L means the sample is whiter/brighter side, -L means the sample darker/blackish side, +a means the sample is redder side, -a means the sample is greener side, +b means the sample is yellowish side and -b means the sample is bluer side. The colour analysis data was shown in table 7.

Techno-economical feasibility of PCMHDP

Note:
- Inventory Theory’s model III is applied which states that economic lot size model with uniform rate of demand, finite rate of replenishment having no shortages. (Including the basic theory of Inventory theory)
- Assumptions: All the assumptions should be made for the production of PCMHDP at minimum level, and Set up cost was assumed on ground reality basis at minimum level.

Table 4: Average sensory score of blend T2 (10:90::FMMP: DTM).

<table>
<thead>
<tr>
<th>Type of FMMP</th>
<th>Moisture (%)</th>
<th>Protein (%)</th>
<th>Fat (%)</th>
<th>Ash (%)</th>
<th>Carbohydrate (%)</th>
<th>Calcium (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCMHDP1</td>
<td>3.98</td>
<td>25.03</td>
<td>1.05</td>
<td>5.39</td>
<td>64.55</td>
<td>1049.94</td>
</tr>
<tr>
<td>PCMHDP2</td>
<td>3.99</td>
<td>25.19</td>
<td>1.13</td>
<td>5.15</td>
<td>64.54</td>
<td>1030.79</td>
</tr>
<tr>
<td>PCMHDP3</td>
<td>3.98</td>
<td>25.01</td>
<td>1.42</td>
<td>5.03</td>
<td>64.56</td>
<td>1018.7</td>
</tr>
<tr>
<td>PCMHDP4</td>
<td>3.98</td>
<td>26.79</td>
<td>2.37</td>
<td>5.23</td>
<td>61.63</td>
<td>1031.46</td>
</tr>
<tr>
<td>PCMHDP5</td>
<td>3.98</td>
<td>25.65</td>
<td>2.09</td>
<td>5.41</td>
<td>62.87</td>
<td>1090.88</td>
</tr>
<tr>
<td>PCMHDP6</td>
<td>3.98</td>
<td>24.71</td>
<td>1.41</td>
<td>5.05</td>
<td>64.85</td>
<td>1028.13</td>
</tr>
<tr>
<td>PCMHDP7</td>
<td>3.98</td>
<td>25.37</td>
<td>2.12</td>
<td>5.07</td>
<td>63.46</td>
<td>1055.65</td>
</tr>
<tr>
<td>PCMHDP8</td>
<td>3.98</td>
<td>24.89</td>
<td>1.05</td>
<td>5.33</td>
<td>64.75</td>
<td>1047.02</td>
</tr>
<tr>
<td>PCMHDP9</td>
<td>3.99</td>
<td>25.10</td>
<td>1.57</td>
<td>5.17</td>
<td>64.59</td>
<td>1030.27</td>
</tr>
<tr>
<td>PCMHDP10</td>
<td>3.98</td>
<td>25.45</td>
<td>1.08</td>
<td>5.05</td>
<td>64.44</td>
<td>1012.17</td>
</tr>
<tr>
<td>PCMHDP11</td>
<td>3.98</td>
<td>26.57</td>
<td>2.36</td>
<td>5.32</td>
<td>61.77</td>
<td>1050.86</td>
</tr>
</tbody>
</table>

Table 5: Chemical composition of the PCMHDP.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particular</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appearance &amp; colour</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>Flavour</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>Mouth feel</td>
<td>7.9</td>
</tr>
<tr>
<td></td>
<td>Over all acceptance</td>
<td>7.43</td>
</tr>
</tbody>
</table>

Table 6: Solubility of the raw materials, their combination and developed product.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Material</th>
<th>Solubility (% w/w)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FMMP</td>
<td>36.05</td>
</tr>
<tr>
<td></td>
<td>Skim milk powder (SMP)</td>
<td>98.93</td>
</tr>
<tr>
<td></td>
<td>FMMP + SMP</td>
<td>65.76</td>
</tr>
<tr>
<td></td>
<td>Developed &amp; selected PCMHDP</td>
<td>85.73</td>
</tr>
</tbody>
</table>

Table 7: Colour analysis data and rancidity of freshly prepared PCMHDP.

<table>
<thead>
<tr>
<th>L</th>
<th>a</th>
<th>b</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.29</td>
<td>6.79</td>
<td>7.07</td>
<td>7.21</td>
</tr>
<tr>
<td>8.7</td>
<td>7.5</td>
<td>7.4</td>
<td>7.5</td>
</tr>
<tr>
<td>9.0</td>
<td>7.5</td>
<td>7.4</td>
<td>7.5</td>
</tr>
<tr>
<td>8.5</td>
<td>7.5</td>
<td>7.4</td>
<td>7.5</td>
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<tr>
<td>7.21</td>
<td>6.79</td>
<td>7.07</td>
<td>7.21</td>
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<td>6.5</td>
<td>6.79</td>
<td>7.07</td>
<td>6.07</td>
</tr>
<tr>
<td>6.64</td>
<td>7.29</td>
<td>8.7</td>
<td>6.64</td>
</tr>
<tr>
<td>2.0</td>
<td>5.5</td>
<td>5.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Figure 2: Average score card of overall acceptability of different PCMHDPs.
Techno-economical feasibility

In the absence of similar work, its techno-economical feasibility cannot be compared. As shown in table 8, production cost of PCMHDP was approximately Rs. 143.55. If we compared it with other health drink powder present in market then it was more economical and also had very high nutritional values; especially in terms of protein and calcium content.

Conclusion

This developed PCMHDP’s protein content was around 5 times while calcium was 2 times higher than similar products available in the market. This product has highly acceptable sensory values even without any addition of either of natural or artificial colour and favour.

Suggestions for future research work

1. Selection of proper packaging material for PCMHDP.
2. Estimation of shelf-life of PCMHDP.
3. In vivo studies (on animals and human).
4. Addition of flavour and colour in the PCMHDP.
5. Micro- nutrient analysis for exact nutritional values of the PCMHDP.

References