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Development and Sensory acceptability of Flavoured Whey Drink incorporated with *Moringa* Leaf Powder

Piverjeet Kaur Dhillon*, Prabjeet Singh
Department of Food and Nutrition Farm Science Centre, Guru Angad Dev Veterinary and Animal Sciences University, Booh, Harike Pattan, Tarn Taran, Punjab, India

Abstract
This study aimed to convert a pollutant i.e. whey into a health promoting drink by incorporating *Moringa* leaf powder (MLP) considered a super food of vegetable origin into it. Furthermore, *Moringa* or some of its part have not been reported to be blended with whey in previously documented studies. On the basis of existing value-added whey technologies, three treatments namely T_1, T_2 and T_3 were developed using medium acidic whey (MAW) (pH = 5.33), sugar and MLP as 99%, 8% and 1%, 98%, 8% and 2%, and 97%, 8% and 3% concentrations, respectively. These treatments were evaluated against T_0 (Plain MAW) for different sensory characteristics *viz.* appearance, colour, flavor, aroma, mouth-feel and overall acceptability through using 9-point hedonic scale. The results revealed that there was a significant difference ($p< 0.05$) in sensory parameters among all the treatments and T_2 was found highly acceptable treatment with mean score of 8.0 for overall acceptability. Bitter taste was observed in T_3, though having overall acceptability score of 7.0 whereas T_0 and T_1 had 4.0 and 6.0 overall acceptability scores, respectively. Flavoured whey drink can be developed by blending MLP at 2% level in 98% of MAW.

Keywords: Moringa flavoured whey drink, MAW, MLP, hedonic scale, sensory characteristics

Introduction

Health drinks have been continued to be emphasized in contemporary era. In dairy industry, whey water is of high significance as it contains key proteins (β-lactalbumin, α-lactalbumin, bovine serum albumin and immunoglobulins) along with amino acids such as leucine responsible for muscle growth and repair and cysteine, involved in different cellular processes in our body such as synthesis of glutathione (a well-known cellular antioxidant) by acting as its substrate. Additionally, it is reported to have good amounts of calcium, vitamin B complex, vitamin C and folic acid (Peter, 2008) [11].

Moringa oleifera leaves, rich in protein, vitamins and minerals (18747.14, 379.83 and 22.05 mg calcium, iron and zinc/ kg of *Moringa* leaves) (Nouman *et al*. 2012; Yang *et al*. 2006; Foidl *et al*. 2001) [2, 9, 14] with low level of oxalates 10.5g/ kg (Teixeira *et al*. 2014) [13], is considered as multipurpose herbal plant with high biotechnological potential. Therefore, this plant can be of multi-therapeutic use *viz.* anemia, scurvy, calcium and zinc deficiency and for boosting the immune system as well. Nonetheless, both the foods possess high nutritive value but consumption for these two miracle foods without intense processing is still not very popular among Indian masses, due to their undesirable appearance, aroma and taste. Since, high cost technologies to process whey and lack of awareness regarding nutritional and non-nutritional benefits of whey and drumstick are key hurdles to utilize these nutritious food componentsin our diets after minimal processing. Moreover, high biological oxygen demand (30,000-50,000 mg/ liter) required for whey disposal is another issue for environmental concern (Gonzalez-Siso, 1996) [3].

On the basis of documented evidences, ample number of research trials has been conducted to develop various value-added whey drinks by incorporating fruit pulps and flavors using spices and herbs (Macwan *et al*. 2016) [8]. However, development studies related to whey-based health drink incorporated with drumstick leaf powder have not been reported so far. In view of above facts, a composite approach by using *Moringa* leaf powder was worked out to test its acceptability in flavoured whey drink.

The ingredients used in the formulations were medium acidic whey (MAW) with pH 5.33, drumstick leaf powder (MLP) (Variety= TNAU-1) and commercial sucrose (sugar), respectively. Whey drink by incorporating *Moringa* leaf powder (MLP) and sugar in it was formulated on the basis of existing value-added drumstick pod powder technology (Khupse *et al*. 2019) [7]. Three treatments namely T_1, T_2 and T_3 were developed using MAW, sugar and MLP in 99%, 8% and 1%, 98%, 8% and 2%, and 97%, 8% and 3% concentrations, respectively.

Above-said treatments were evaluated against T_0 (control) i.e. plain MAW. The developed products were evaluated for different sensory characteristics *viz.* appearance, colour, flavor, aroma, mouth-feel and overall acceptability by a panel of 10 semi-trained judges using 9-point hedonic scale. Further, Index of acceptability was calculated through formulae mentioned below and expressed in terms of percentages.

$$\text{Index of acceptability} = \frac{\text{Total sum of all sensory parameters/ No. of parameters}}{\text{Highest value of Hedonic Scale (9 or 8)}} \times 100$$

Obtained data on sensory characteristics of *Moringa* flavoured whey drink was subjected to One-way ANOVA (analysis of variance) with Tukey's post-hoc test (GraphPad Prism Inc. USA) to investigate difference between acceptability levels of *Moringa* flavoured whey drink treatments. The results revealed that there was a significant

difference ($p<0.05$) in sensory parameters among all the variations (Table 1). Mean overall acceptability score of 8.0 and 7.5 was observed in T_2 and T_3, while it was below average in T_0 and T_1, respectively.

Table 1: Sensory evaluation of *Moringa* flavoured whey drink

Parameters	T_0	T_1	T_2	T_3
Appearance	6.0 ± 0.4^{c}	7.1 ± 0.3^{b}	8.4 ± 0.2^{a}	7.3 ± 0.4^{b}
Colour	5.0 ± 0.4^{d}	6.5 ± 0.2^{c}	8.5 ± 0.3^{a}	7.5 ± 0.5^{b}
Texture	4.2 ± 0.1^{c}	7.0 ± 0.2^{b}	8.2 ± 0.1^{a}	7.1 ± 0.3^{b}
Taste	4.0 ± 0.6^{d}	6.8 ± 0.4^{c}	8.5 ± 0.3^{a}	7.4 ± 0.6^{b}
Flavour/ Aroma	4.0 ± 0.6^{d}	6.4 ± 0.7^{c}	8.5 ± 0.6^{a}	8.0 ± 0.7^{b}
Mouth feel	5.0 ± 0.5^{d}	6.0 ± 0.4^{c}	8.4 ± 0.2^{a}	7.0 ± 0.3^{b}
Overall Acceptability (O. A.)	4.0 ± 0.5^{d}	6.0 ± 0.4^{c}	8.0 ± 0.3^{a}	7.5 ± 0.5^{b}
Index of Acceptability (I. A.) (%)	51.1	72.6	92.8	82.2

*Values are Mean ± SD from ten determinations; different superscripts in the same row are significantly different ($p<0.05$) Where T_0 = Plain medium acidic whey (pH = 5.33) T_1 = MAW, sugar and MLP 99%, 8% and 1% T_2 = MAW, sugar and MLP 98%, 8% and 2% T_3 = MAW, sugar and MLP 97%, 8% and 3%

In contemporary times, awareness among consumers regarding artificial and natural flavours has increased as compared to the past. It is worth-mentioning here that approximately half of the original milk solids are present in whey and it contributes towards significant number of micronutrients such as vitamins and minerals (Gupta , 2000). Alongside, protein is also present in fair amounts. Therefore, in current study, we have incorporated natural *Moringa* flavor to aid the health and well-being of the consumer via declining their dependency on artificially-flavoured beverages available in the market.

Moringa oleifera, though being underutilized, is also known as miracle food since it is a nutrient powerhouse. All parts of the tree (stem, leaves, pods etcetera) are edible. World Health Organization (WHO) also promotes this vegetative component to replace exotic foods to alleviate malnutrition since the year 1988 (Johnson 2005) [6]. Drying (sun, shade, oven and freeze) between the temperature of 50 to 60°C and grinding of *Moringa* leaves to fine powder provides viability to retain both macro and micronutrients in the final dried product (Ali *et al*. 2017) [1].

Sensory aspect of the product is of utmost significance when the newly developed food product is about to be launched in the market. Hence, during present study, sensory attributes were considered as the deciding factor for the acceptability of *Moringa* flavoured whey drink. When dairy waste (whey) is blended with vegetable/ fruit pulp, it provides advantages to the consumer as well as the dairy sector (Sakhale *et al*. 2012) [12]. In light of existing review of literature, MLP has been added to diverse dairy products *viz.* cheese and yoghurt which exhibit acceptable sensory findings (Oyeyinka and Oyeyinka, 2018) [10]. Further, Khupse *et al*. 2019 [7] reported that 1.5% *Moringa* pod powder can be blended with whey for highest sensory acceptability in terms of flavor and colour, correspondingly.

The present study demonstrated that value added flavoured whey drink can be developed through combining whey, sugar and drumstick leaf powder at 98, 8 and 2% levels to provide improved sensory scores.

Conflict of Interest

The authors declare that they have no conflict of interest.

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