

Effect of Functional Ingredients on the Sensory Characteristics of Ready to Use Coffee Beverage

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Abstract:- The present research was carried out to study the effect various functional ingredients on the sensory characteristics of ready to use health beverage. Ready to use coffee beverage was prepared by using double toned milk and replacement of part of milk with functional ingredients such as cheddar cheese whey (20, 30 & 40 %), incorporation of stevia:sugar (0:100, 25:75, 50:50 & 100:00) blend, walnut oil (2, 3 & 4 %) and coffee decoction (10, 15 & 20 %) which was optimised by sensory evaluation. Finally, based on sensory scores 30 % whey, 0:100 stevia:sugar ratio, 2 % walnut oil and 15 % coffee decoction was optimised and the ready to use coffee beverage was developed.

Keywords:- Whey, Stevia, Walnut Oil, Coffee & Sensory Properties.

I. INTRODUCTION

Generally, Milk is often called as complete food and form an important part in our daily diet. Use of low fat or reduced fat product is gaining popularity as a form of low calorie products due to positive impact on the human physiology and metabolism. There different varieties of milk based beverages such as fat free, low fat, flavoured milks either enriched or supplemented with some nutrients such as whey proteins, fruit pulps, herbs and certain micro and macro nutrients etc. Hence, different types of functional beverages are growing promptly in the soft drinks markets because of their health reimbursements such as immune enhancing, promoting health benefits for digestive or heart health, sporting drinks etc. Milk-based drinks are among the beverages with the longest history of consumption. Milk-based beverages are liquid, processed milk products. They are mixtures of milk or milk powder with water added with additives for example colorants, flavours, acids, functional ingredients, fruit mixes/juices, sugar and preservatives. The milk-based beverages market is still a niche market. However, there have been many innovations and currently it is one of the fastest growing dairy segments (Paquin, 2009).

The global non-alcoholic beverage such as fruits beverages, functional beverages market size was valued at USD 967.3 billion in 2016 (Grand view research, 2017). The non-alcoholic beverage market size in India has a currently reached to Rs. 195,000 crores. The coffee & tea beverage industry market has reached Rs 41,800 crores at the end of 2017 as the domestic consumption is rising expeditiously (Bhansal, 2017).

Disposal of whey has always been environmental problem due to its high Biological Oxygen Demand (BOD) hence utilization of whey in production of various beverages can be of great use. Whey constitutes 45-50 % of total milk solids, 70 % of milk sugar (lactose), 20 % of milk proteins and milk minerals of about 70-90 % and most importantly, almost all the water soluble vitamins originally present in milk (Ozen and Kilic *et al.*, 2009). Proteins that constitute whey protein concentrate include β -lactoglobulin and α -lactalbumin, proteose peptone, immunoglobulins, bovine serum albumin, lactoferrin, lactoperoxidase, and some peptides such as glycomacropeptide, which is the source of Branched-Chain amino acids.

Whey proteins are rich in essential amino acids and have high Protein Efficiency ratio (PER-3.6), Biological Value (BV-104) and Net Protein Utilization (NPU-95) (Rebaca, 2013). Watson *et al.* (2016) reviewed that whey protein is an excellent both in terms of nutritional and economic point of view. Studies have shown that whey protein possess antidiabetic, insulinotropic, antioxidant potential, immunomodulating, antiviral and antimicrobial effects, anticancer and anti-ulcer activity, and protect the cardiovascular system etc. which suggests it may have functional benefits to treat several diseases. Whey proteins could be used as component of foods for functional, nutritional and economic benefits.

Stevia plant was first discovered in 1987 by Bertoni in Paraguay. Stevia (*Stevia rebaudiana bertoni*) is a herb of the 950 genera of *Asteraceae* family well known locally as a sweet herb or honey leaf, widely used by herbalists as sweetener and has been used traditionally in the treatment of diabetes. The leaves of stevia contains diterpene, glycosides, stevioside, rebaudiosides A-F, steviolbioside and dulcoside, which are found to be responsible for its sweet taste and is found to have commercial importance all over the world as a source of sugar substitute in foods, beverages or medicines. Stevia leaves contain zero-calorie and tastes 300 times sweeter than sucrose. Stevia has been shown to be safe and JEFCA has established an ADI of 4 mg/Kg body weight. The leaves of stevia also contains about 6.2 % protein and 5.6 % lipid on a dry-weight basis, as well as diterpene, triterpenes, sterols, flavonoids and other compounds (Kuntz *et al.*, 2010). Stevia is gaining popularity due to its potent low calorific value, sweetening power, nutritional and therapeutic values. Hence, can be used in developing low calorie health beverages.

Walnut (*Juglans regia L.*) is a member of Juglandaceae family, one of the finest nuts of the temperate regions. Ripe walnut are eaten as dessert nuts or used in cakes, desserts and confectioneries. Walnuts contain about 52 - 70 % fat, 3.2 - 4.4 % water, 12.0-19.6 % protein, 61.3 - 73.8 % fat, 1.8 - 2.3 % ash and 2.2 - 4.5 % sugars (Gecgel *et al.*, 2017). Walnuts are rich in Polyphenols such as ferulic acid, vanillic acid, coumaric acid, syringic acid, myricetin and juglone, iron (16 %), Vitamin B6 (25 %), Magnesium (39 %) and Vitamin C (2 %). Walnuts are rich good fat, is also rich i.e. 100 g of walnut contains approximately 6.5 g of saturated fat, 47 g of polyunsaturated fat and 9 g of monounsaturated fat (Linda *et al.*, 2004). It is also reported that walnuts have many health beneficial properties such as antifungal activity, antiviral activity, antioxidant activity, antidiabetic, antidepressant activity, antityrosinase activity, anthelmintic activity, hepatoprotective activity, hypotriglyceridemic activity, anticancer activity and many other medicinal uses (Fukuda *et al.*, 2004 and Taha *et al.*, 2011). Hence, addition of walnut oil to health beverage provides both nutritional as well as therapeutic benefits.

Coffee (*Coffea arabica* or *Coffea robusta*) is the second most common beverage in the world after tea, and has shown positive impact on nutritional health. Coffee, in addition to the best known component of the beverage, caffeine contains about 2000 chemicals which include many bioactive compounds with potential effects on health. The amount of caffeine and other components of coffee in the final beverage is variable and depends on type of coffee powder, brewing method, method of preparation, and cup size (Wilson and Temple., 2016). Coffee is the biggest source of antioxidants in the diet. The global output of coffee in 2017 is around 158.93 million kg where in India it was around 5.84 million kg 100 g of Coffee consists of caffeine (40 mg), potassium (49 mg) and sodium (2 mg)

(International coffee organization, 2018). Coffee is one in every of foremost wide consumed beverages globally. Clinical and epidemiological studies have found the consumption of coffee to be associated with risk reductions for the development of diabetes, Alzheimer's disease, several cancers, liver diseases and cardiovascular disease due to its bioactive constituents, which include phenolic compounds, caffeine, diterpenes, melanoidins, and trigonelline (Loader *et al.*, 2017).

II. MATERIALS AND METHOD

A. Ingredients

Fresh whole milk was procured from Students Experimental Dairy Plant (SEDP) of Dairy Science College, Hebbal, Bengaluru, which was subjected to cream separation to obtain double toned milk using cream separator, skim milk powder and cream was used for standardized to obtain double toned milk (1.5 % Fat & 9 % SNF) and this was used in preparation of ready to use health beverage. Cheddar cheese whey was prepared by using method prescribed by Singh (2006). Good quality cane sugar was procured from the local market. Stevia a natural sweetener was procured from Jhanil Healthcare Pvt. Ltd., Punjab (1gm of powder was equivalent to 2 teaspoons of sugar). Walnut oil and coffee powder was procured from local market and their decoction was used in the preparation of ready to use health beverage.

B. Production of Ready to use Health Beverage

The control beverage was prepared as per the standard procedure (Singh., 2006). Sugar sweetened beverage will be prepared using 8 % sugar (on milk total volume basis) and pasteurized at 72 °C/5-6sec and then cooled to room temperature and stored at refrigeration temperature (Figure 1).

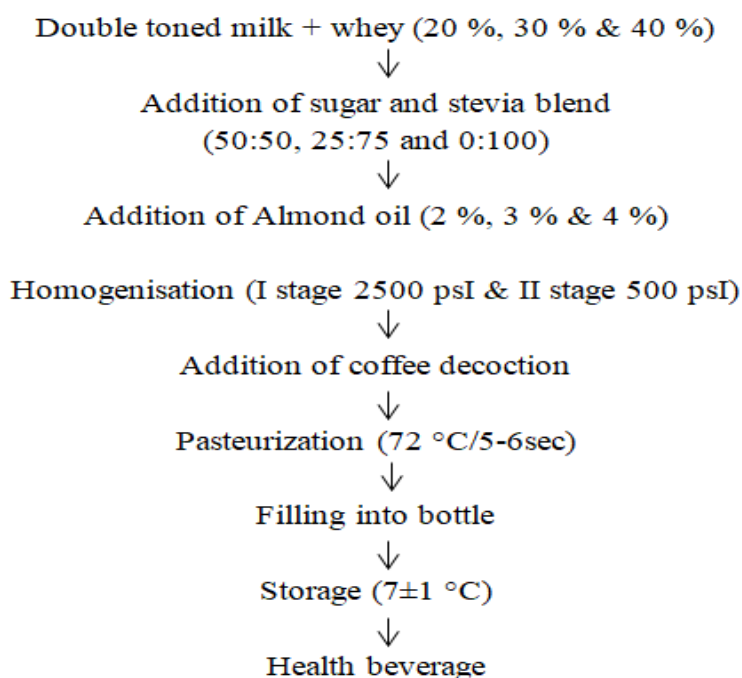


Fig 1:- Flow chart for production of ready to use health beverage

C. Sensory Evaluation

The ready to use health beverage was prepared by replacing double toned milk with whey at different ratios and addition of sugar:stevia blend, almond oil and tea decoction and subjecting to sensory evaluation by a trained sensory panels using a 9 point hedonic scale for colour and appearance, body and texture, flavor and overall acceptability. The scores given by panel of judges were then statistically analysed.

D. Statistical Analysis

The design of experiment was statistically analysed. Results are the average of three replications which was statistically analysed by subjecting to statistical analysis (R Programme, R-Version, R386 3.4.3) for accurate interpretation that helped in discussion (Zar, 2003).

III. RESULT AND DISCUSSION

A. Effect of Different Levels of whey on the Sensory Characteristics of Health Beverage

Different blends of double toned milk and cheddar cheese whey were tried i.e. 80:20, 70:30 and 60:40 to know the acceptability of product against the control beverage (100:00). The resultant health beverage and control sample was served to a panel of judges for adjudging the sensory characteristics and overall acceptability. The highest sensory score compared to control was given to the beverage containing double toned milk and whey at 70:30 blend. The mean sensory score for this blend for colour and appearance, body and texture, flavour and overall acceptability were 8.05, 8.15, 8.20 and 8.25, respectively. Hence, 70:30 blend of double toned milk and whey was selected and used for further studies which differed significantly ($P < 0.05$) and rated best among others blends (Table1). These findings were in support with the results of Yadav *et al.* (2016) reported that addition of soya milk and whey in equal proportion with 8 % sugar was awarded with highest sensory score i.e., 7.50, 7.33, 7.16 and 7.33 for colour and appearance, mouth feel, flavour and overall acceptability, respectively.

Levels of whey replacement (%)	Colour and appearance	Body and texture	Flavour	Overall acceptability
Control	8.27 ^a	8.22 ^a	8.30 ^a	8.38 ^a
20	7.72 ^b	7.85 ^b	7.51 ^a	7.70 ^b
30	8.05 ^{ab}	8.15 ^a	8.20 ^{ab}	8.25 ^a
40	6.50 ^c	6.36 ^c	6.55 ^c	6.75 ^c
CD ($P=0.05$)	0.22	0.25	0.25	0.25

Table 1:- Effect of different levels of whey on the sensory characteristics of health beverage

Note

- All values are average of three trials
- Superscripts a, b & c indicate significance difference at the corresponding critical difference
- Control – Double toned milk with 8 % sugar

B. Effect of Different Levels of Stevia on the Sensory Characteristics of Health Beverage

Sugar and Stevia blend was added in the ratio of 50:50, 25:75 and 0:100 to ready to use health beverage (The sweetness intensity of stevia was 10 times higher than that of sugar). The resultant health beverage and control sample was served to a panel of judges for adjudging the sensory characteristics and overall acceptability. Based on sensory

evaluation health beverage with 0:100 blend of sugar and stevia was selected against control. The mean sensory scores for 0:100 blend of sugar and stevia for colour and appearance, body and texture, flavour and overall acceptability are 8.00, 8.06, 8.12 and 8.00, respectively. Hence, 00:100 blend (sugar:stevia) was selected and used for further studies which differed significantly ($P < 0.05$) and rated best among others blends (Table 2). These findings were in support with Tadhani and Subhash (2009), they reported that replacement of sucrose with stevia up to 50 % and 75 % was acceptable in tea and coffee with flavor scores of 8.0 and 8.2 and overall acceptability scores of 8.0 and 8.4, respectively with non-significant difference in colour and appearance.

Combination of sugar and stevia	Colour and appearance	Body and texture	Flavour	Overall acceptability
Control	8.05	8.15 ^a	8.20 ^a	8.25 ^a
50:50	7.25	7.45 ^b	7.40 ^{ab}	7.43 ^b
25:75	7.56	7.75 ^{ab}	7.65 ^{ab}	7.75 ^b
0:100	8.00	8.06 ^{ab}	8.12 ^a	8.00 ^a
CD ($P=0.05$)	0.35	0.28	0.29	0.33

Table 2:- Effect of different levels of stevia on the sensory characteristics of health beverage

Note

- All values are average of three trials
- Superscripts a, b & c indicate significance difference at the corresponding critical difference
- Control – 30 % whey added health beverage
- Sweetness intensity of stevia is 10 times more than sugar and equivalent quantity of stevia was added.

C. Effect of Different Levels of Walnut Oil on the Sensory Characteristics of Health Beverage

Walnut oil was added at 2, 3 and 4 % to the health beverage. The results pertaining to the addition of almond oil on colour and appearance, body and texture, flavour and

overall acceptability of the health beverage was adjudged by panel of judges which is depicted in Table 3. However, it was observed that with increase in per cent of walnut oil, the sensory scores were decreasing. The highest sensory score was awarded to health beverage added with 2 % walnut oil against control. The mean sensory score for health beverage with incorporated with 2 % walnut oil for colour and appearance, body and texture, flavour and overall acceptability were 8.31, 8.21, 8.18 and 8.40. Hence, health beverage incorporated with 2 % almond oil was selected and used for further studies which differed significantly ($P < 0.05$) and rated best among others blends (Table 3).

Levels of walnut oil (%)	Colour and appearance	Body and texture	Flavour	Overall acceptability
Control	8.05 ^a	8.15 ^a	8.00 ^a	8.25 ^a
2	8.31 ^a	8.21 ^a	8.18 ^a	8.40 ^a
3	7.50 ^b	7.87 ^b	7.43 ^{ab}	7.68 ^{bc}
4	7.43 ^b	7.56 ^b	7.25 ^b	7.62 ^c
CD ($P=0.05$)	0.24	0.33	0.31	0.26

Table 3:- Effect of different levels of walnut oil on the sensory characteristics of health beverage

Note

- All values are average of three trials
- Superscripts a, b & c indicate significance difference at the corresponding critical difference
- Control – 30 % whey, 0:100 sugar and stevia ratio added health beverage

D. Effect of Different Levels of Coffee on the Sensory Characteristics of Health Beverage

Effect of replacement of health beverage with coffee decoction at 15, 20 and 25 % were tried and the results pertaining to sensory evaluation are depicted in Table 4. It was observed that with increase in per cent replacement of health beverage with coffee decoction, the sensory scores for all attributes were decreasing. The highest sensory score was awarded to health beverage containing 15 % coffee

decoction compared to control. The mean sensory score of health beverage containing 15 % coffee decoction were 8.25, 8.8, 8.32 and 8.20 with respect to colour and appearance, body and texture, flavour and overall acceptability. Finally, health beverage prepared with 15 % replacement with coffee decoction was optimized. Similar observation were supported by Chakraborty *et al.* (2017) for yoghurt where in sensory scores for colour and overall acceptance of Y2 were highest i.e. 7.75 and 7.95, respectively whereas flavour scores of Y1 were highest that is 7.48. Also colour and appearance, mouth-feelness and overall acceptability of Y2 (made with aspartame) were 8.7 %, 1.2 %, 5.23 % and 5.3 % higher than Y1 (made with table sugar), respectively.

Levels of coffee decoction (%)	Colour and appearance	Body and texture	Flavour	Overall acceptability
Control	8.35 ^a	8.43 ^a	8.30 ^a	8.31 ^a
15 (85:15)	8.25 ^a	8.38 ^a	8.32 ^a	8.20 ^a
20 (80:20)	7.75 ^b	7.62 ^b	7.70 ^b	7.56 ^b
25 (75:25)	7.50 ^b	7.37 ^b	7.56 ^b	7.37 ^b
CD ($P=0.05$)	0.21	0.23	0.22	0.20

Table 8:- Effect of different levels of coffee on the sensory characteristics of health beverage

Note

- All values are average of three trials
- Superscripts a, b & c indicate significance difference at the corresponding critical difference
- Control – Health beverage (30 % whey, 0:100 sugar

:stevia, 2 % almond oil and walnut oil blend, 10 % (90:10) coffee decoction)

IV. CONCLUSION

The present investigation carried out to study the effect of various functional ingredients on the sensory attributes during development of ready to use health beverage. It was found out that the health beverage prepared using 70:30 blend of double toned milk and whey, addition of 00:100 blend of sugar and stevia, incorporation of 2 % walnut oil and addition 15 % of coffee decoction has many health beneficial properties. Development these types of health beverage can be commercialised which would provide nutrients required in daily diet.

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