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Vaishali Matpathi

Assistant Professor, Directorate
of Extension, KVAFSU, Bidar,
Karnataka, India

Vijay Kumar

Department of Surgery,
Veterinary College, Bidar,
Karnataka, India

Jayashri Mahadev Swamy

Department of Aquaculture,
College of Fisheries, Mangalore,
Karnataka, India

DB Puranik

Retired Professor, Dairy
Technology KVAFSU, Hebbal,
Bengaluru, Karnataka, India

Corresponding Author:

Vaishali Matpathi

Assistant Professor, Directorate
of Extension, KVAFSU, Bidar,
Karnataka, India

To study the physico-chemical and rheological characteristics of geriatric health beverage

Vaishali Matpathi, Vijay Kumar, Jayashri Mahadev Swamy and DB Puranik

Abstract

The research was carried out to study the physico-chemical and rheological characteristics of geriatric health beverage. Geriatric health beverage was prepared by using cow milk, ragi malt (2, 4 and 6%) whey protein concentrate (3, 5 and 10%), lactoferrin (15, 20 and 25 ppm), bacteriocins (10, 15 and 20 ppm) and probiotics (*L. acidophilus* LA5 and *B. bifidum* BB12 (1:1) (Mixed culture at, 2, 3 and 4%) which was studied for physico-chemical and rheological characteristics. Finally, based on these characteristics, geriatric health beverage was prepared. The study concluded that the geriatric health beverage prepared using cow milk, ragi malt (4 percent), whey protein concentrate (3, 5 and 10 percent), Lactoferrin, Bacteriocin, sugar (6, 8, 10%) and probiotics (2, 3, 4%) provided excellent physico-chemical and rheological characteristics.

Keywords: Cow Milk, WPC, ragi malt, lactoferrin, bacteriocin, probiotics

1. Introduction

The benefit of good nutrition to health is considered as important to elderly as it is to younger people. Conversely nutritional deficiency has been associated with numerous health problems in the elderly involving anemia, anorexia and weight loss, constipation, dehydration, gastric atrophy, cancer, vision disorders, coronary heart disease, diabetes and osteoporosis, infections. Geriatric foods can take care of certain aspects related with geriatric healthy nutrition.

Whey protein concentrate (WPC) is widely used in the various food and dairy formulations, in view of its excellent nutritional and functional properties. WPC provides a wide range of functionalities such as solubility, viscosity, water binding, whipping, emulsification and gelation, which aid in increasing its utilization in variety of food formulations. Lactoferrin is considered to be an important host defense molecule and has a diverse range of physiological functions such as antimicrobial/antiviral, immunomodulatory, and antioxidant activity. During the past decade, it has become evident that oral administration of lactoferrin exerts several beneficial effects on the health of human and animals, including anti-infective, anticancer, and anti-inflammatory effects. This has strengthened the potential of lactoferrin as a food additive. The recent trend in food industry is to use bio preservatives in the form of active cultures or metabolites from various microbes like enzymes and bacteriocins. Lactic acid bacteria have the potentiality to inhibit the growth of pathogenic and food spoilage organisms (Sablon *et al.*, 2000) [5]. They do not pose any risk to human health and designated as food grade organisms. Bacteriocins produced by these organisms have a great potential to use as food preservative. It can also be incorporated in to food formulations by isolating active fraction followed by purification. In this system, the purified protein is considered as new food additive and requires approval of regulatory bodies.

The probiotics are live organisms, which upon ingestion in certain number exert health benefit besides inherent basic nutrition. Probiotics should be live upon ingestion and must be in high number to exert any physiological effect. Some of the potential health benefits of probiotics are significantly quite well established and is being explored in the formulation of some health foods. The use of Lactic Acid Bacteria and lactobacilli is Generally Regarded as Safe (GRAS). *Bifidobacterium bifidum* and *Lactobacillus acidophilus* containing products could normalize intestinal micro flora and are useful in treatment of acute intestinal disorder and chronic disorder of digestive systems.

Beverages containing probiotic organisms have numerous benefits as compared to their cultured products. The commercial interest in functional foods containing probiotics are gaining significance in view of increasing studies on their role in digestive tract. Developing of a health food beverage could be a solution for the problem of the geriatrics. Health food beverage consisting of whey protein concentrate, lactoferrin, bacteriocins, and probiotics will have a beneficial effect on the gut micro flora of the geriatrics. Whey protein concentrates takes care of the protein requirement, lactoferrin takes care of the iron that is required for geriatrics, lactic acid bacteria and bacteriocins will be helpful in establishing good number of micro flora in the intestinal tract which will prevent the growth of putrefactive bacteria.

2. Materials and Methods

Fresh cow milk procured from Student Experimental Dairy Plant of Dairy Science College, Bangalore was used for the preparation of geriatric health beverage.

Skim milk powder “Nandini” brand skim milk powder manufactured by Karnataka Milk Federation was procured from the local market to standardize the geriatric health beverage.

Ragi malt Good quality Ragi malt was procured from the local market was used in the preparation of geriatric health

beverage.

Whey Protein Concentrate. Fresh spray dried Whey Protein Concentrate having 70% protein was procured from Mahan Proteins Ltd., Mathura, Uttar Pradesh, was used for the enrichment of geriatric health beverage.

Lactoferrin Lactoferrin was isolated from cheese whey in the PG laboratory of department of dairy technology.

Bacteriocin Bacteriocin was isolated from lactic acid bacteria in the PG laboratory of department of dairy technology.

Sugar Good quality cane sugar was procured from the local market and used in the preparation of geriatric health beverage.

Stabilizers Food grade Carboxy Methyl Cellulose (CMC) was procured from Lucid Colloids Ltd. Jodhpur and was used as stabilizer.

3. Preparation of geriatric health beverage

Whey protein concentrate with suitable protein content is to be reconstituted in water as a 10% solution. Heat treat the solution to 80° for 30 min. and inoculate with lactobacillus acidophilus or lactobacillus bifidus after adjusting pH (Puranik, 1996) [4], with slight modification which has been made to optimize the functional geriatric health beverage. The flow diagram for preparation as follows.

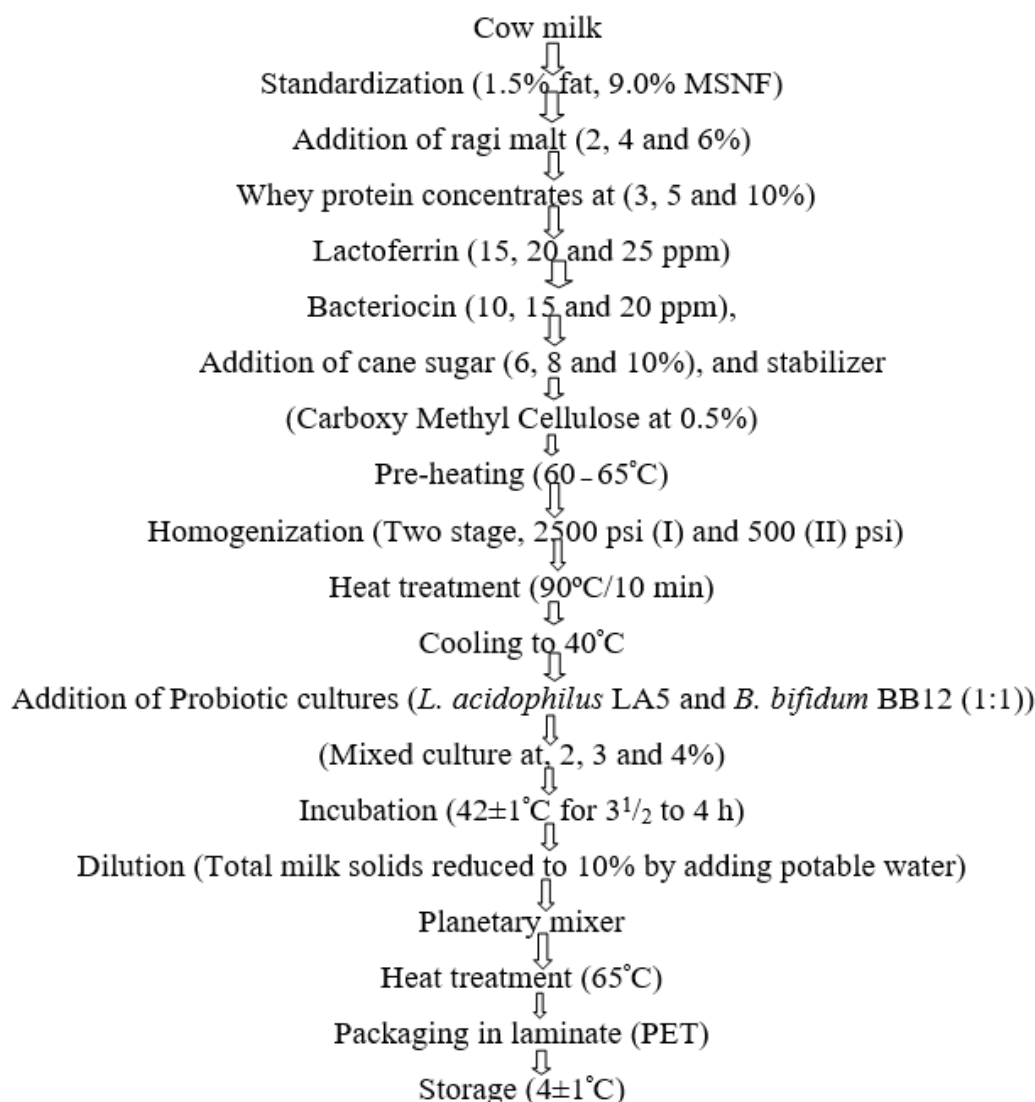


Fig 1: Flow diagram for the preparation of probiotic geriatric health beverage

4. Results and Discussion

4.1 Physiological properties of Bacteriocin producing *Lactobacillus* isolates:

Three best *Lactobacillus* species LB1, LB2 and LB3, identified by the diameter of zone of inhibition were tested for its effects on different conditions like temperature, pH and its ability to grow in the presence of Sodium Chloride by varying the concentration. Abundant growth was observed for all three species at 45 °C while it was weak at 37 °C and no growth was observed at 10 °C. The results are shown in Table 1. Effect of different pH on the growth of *Lactobacillus* species was also studied. Growth was observed for all the three species at pH 4.3 and 6.5, while, no growth was observed at the pH 8.5 and 9.0. Salt tolerance of *Lactobacillus* species was tested with 6.5, 10 and 15% concentration of Sodium Chloride and no growth was observed.

Table 1: Physiological properties of Bacteriocin producing *Lactobacillus* isolates

Tests	Isolates	LB1	LB2	LB3
Growth at Temp (°C)	4	-	-	-
	10	-	-	-
	37	+	+	+
	45	++	++	++
Growth at pH	4.3	+	+	+
	6.5	+	+	+
	8.5	-	-	-
	9.0	-	-	-
Growth at NaCl (%)	6.5	VW	VW	VW
	10	-	-	-
	15	-	-	-

(+) Growth, (-) No growth, (++) Luxurious Growth, (VW) very weak

4.2 Probiotic cultures on viable counts, acidity and pH in geriatric beverage:

The effect of different levels of probiotic cultures on viable counts, acidity and pH in geriatric health beverage are presented. The viable count with respect to *L. acidophilus* with 2, 3 and 4% of inoculation was, 7.92, 8.35 and 8.89 log₁₀ cfu/ml, respectively. The viable counts of *B. bifidum* in geriatric beverage were 7.36, 7.81, and 8.26 log₁₀ cfu/ml. As the level of inoculation increased, the viable counts of both the cultures increased significantly.

The acidity and pH of the enriched geriatric health beverage increased from 0.70 to 0.78% lactic acid with corresponding decrease in pH (4.64 to 4.40) with the increase in level of inoculation from 2 to 4%. Statistical analysis confirmed that there is a significant effect of different levels of probiotic cultures on increase in acidity and corresponding decrease in pH of the geriatric health beverage. Hence 3 percent of probiotic inoculation was taken as the selected for the addition in the geriatric health beverage taking in to consideration the viability of probiotic culture and the corresponding acidity.

Table 2: Probiotic cultures* on viable counts, acidity and pH in geriatric beverage#.

Inoculation level (%)	Viable counts (Log ₁₀ cfu/ml)		Acidity (% lactic acid)	pH
	<i>L. acidophilus</i>	<i>B. bifidum</i>		
Control (0)	-	-	0.69	4.75
2	7.92	7.36	0.70	4.64
3	8.35	7.81	0.72	4.54
4	8.89	8.26	0.78	4.4
CD	0.1	0.133	0.029	0.059

*All the values are average of 3 trials
#*L. acidophilus* and *B. bifidum*

4.3 Physico-chemical properties of developed geriatric health beverage

Ragi malt, WPC, lactoferrin, probiotics and bacteriocin were incorporated in the developed geriatric health beverage at the rate of 4 percent, 5 percent, 20 ppm, 3 percent and 20 ppm levels, respectively. The effect of addition of ragi malt, WPC, lactoferrin, probiotics and bacteriocin on some of the physicochemical properties of geriatric health beverage.

Addition of ragi malt only in case of geriatric health beverage. The total solids increased to 22.14 percent as against control 10.5 percent in case of 4 percent level of ragi malt. The corresponding pH of geriatric health beverage decreased to 6.50 as against for control 6.60, whereas acidity increased to 0.18 percent of LA as against for control 0.14 percent of LA. The extent of decrease in pH and increase in acidity was found to be significant. With 4 percent level of ragi malt the viscosity of geriatric health beverage increased to 4.19cP as against control 3.15cP for control. The viscosity and total solids were found to be significant

WPC is used in geriatric health beverage at 5 percent levels. In this case the total solids increased to 26.97 percent. The pH of geriatric health beverage decreased to 6.45, whereas acidity increased to 0.20 percent. The extent of decrease in pH and increase in acidity.

Table 3: Physico-chemical properties of geriatric health beverage*

Parameters	Total solids (%)	Acidity Lactic acid (%)	pH	Viscosity (cP)
Control#	10.5	0.14	6.60	3.15
D1	22.14	0.18	6.50	4.19
D2	26.97	0.20	6.45	4.58
D3	25.9	0.19	6.48	4.45
D4	28.93	0.72	4.69	4.55
CD	0.315	0.049	0.122	0.111

*All the values are average of 3 trials

#Control: Double toned milk

D1: Malted geriatric health beverage

D2: Malted geriatric health beverage with WPC

D3: Malted geriatric health beverage enriched with lactoferrin

D4: Functional geriatric health beverage enriched with probiotics and bacteriocin

With the 5 percent level of WPC addition the viscosity of geriatric health beverage increased to 4.58 cP. The viscosity and total solids were found to be significant. Lactoferrin is used in geriatric health beverage at 20 ppm levels. However no significant difference was observed in any of the attributes. Probiotic culture is used in geriatric health beverage at 3 percent levels. The total solids increased 28.93 percent. The pH of geriatric health beverage decreased to 4.69, whereas acidity increased to 0.72 percent of LA. The extent of decrease in pH and increase in acidity was found to be significant. With the 3 percent level the viscosity of geriatric health beverage increased to 4.55 CP. The viscosity and total solids were found to be significant.

4.4 WPC on chemical composition of geriatric health beverage

The chemical compositions of geriatric health beverage prepared by addition of 3 to 10% levels of WPC are presented. The protein, carbohydrate, fat and ash content of geriatric health beverage increased with increased level of addition of WPC. The higher protein (7.18%), carbohydrate (16.91%), fat (1.88%) and ash content (0.88%) of the geriatric

food at 5% level of addition of WPC could be attributed to the higher percentages of protein, carbohydrate, fat and ash content of WPC which was incorporated in the health beverage. Further it could be observed that the percentage increasing trend of all the components at all levels of WPC addition. But for economic reasons, 5% level of WPC addition was optimized. The results of the present investigation are in agreement with the observations made by Opdhal and Baer, (1991)^[1]. Decrease in moisture content of the geriatric health beverage was noticed with increase in the level of WPC. This may be due to the water holding capacity of WPC, where adsorption of moisture by WPC leads to reduce the availability of free moisture (Parris *et al.*, 1997)^[2].

4.5 Morphological, biochemical and physiological properties and different level of inhibition of bacteriocin on indicator organisms

As could be seen from table 1, 2, and 3 which, the formulated geriatric health beverage developed was found to contain bacteriocin producing organisms. The bacteriocin producing isolates were identified based on their morphological, cultural, biochemical characteristics. Three best *Lactobacillus* species LB1, LB2 and LB3, identified by the diameter of zone of inhibition were tested for its effects on different conditions like temperature, pH and its ability to grow in the presence of Sodium Chloride by varying the concentration. Luxurious growth was observed for all three species at 37°C while it was weak at 45°C and no growth was observed at 10°C. Effect of different pH on the growth of *Lactobacillus* species was studied. Growth was observed for all the three species at pH 4.3 and 6.5, while, no growth was observed at the pH 8.5 and 9.0. Salt tolerance of *Lactobacillus* species was tested with 6.5, 10 and 15% concentration of Sodium Chloride and no growth was observed in the subsequent concentrations of Sodium Chloride. The results were in agreement with. The beverage containing bacteriocin was studied for the inhibition of indicator organism at various levels *viz.*, 10, 15 and 20 ppm concentrations. It was observed that the inhibition of the indicator organism was observed at all levels of addition and the inhibition pattern was observed to be in the increasing trend with the increase in the level of bacteriocin addition.

4.6 Probiotic cultures on viable counts, acidity and pH in geriatric beverage

The viability of *L. acidophilus* and *B. bifidum* cultures increased in geriatric health beverage as the level of inoculation increased. There was also a corresponding increase in acidity and decrease in pH as the level of incorporation increased. The acidity and the viability of probiotic culture were found to be optimum at 3% level of probiotic addition. Further increase in the level of inoculum with probiotic culture, resulted in increased acidity in the product. It is quite obvious that the acidity increases with the increase in the level of probiotic culture with a corresponding decrease in the pH. Similar observations were made with regard to viability of *Bifidobacterium bifidum* and *Lactobacillus acidophilus* probiotic cultures beyond 3 percent level in fermented foods (Prabha, 1999)^[3].

5. Conclusion

The present investigation carried out to study the physico-chemical and rheological properties of geriatric health beverage. Ingredients like whey protein concentrate (WPC),

lactoferrin, bacteriocin and probiotics play an important role developing a nutraceutical and functional beverage of the geriatrics. The study concluded that the bio-ingredients like WPC, lactoferrin, bacteriocin and probiotics could be easily incorporated in the geriatric foods with excellent physico-chemical properties of geriatric health beverage. The results indicated that use of 4% of ragi malt, 5% of WPC, 20ppm of lactoferrin, 20ppm of bacteriocin and 3% of probiotic culture with double toned milk as the base material was found to be optimum and had no adverse effect on physico-chemical and rheological properties of the geriatric health beverage.

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