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SHORT COMMUNICATION

Effect of blends of Sorghum (Great millet) and whey protein concentrate on the quality characteristics of *lassi*

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Abstract: An attempt has been made to address the iron and fibre deficiency in dairy products (*lassi*) by utilizing various levels of germinated sorghum flour and whey protein concentrate (WPC-80). Sorghum is one of the significant members among millets and WPC is one of major by-product of dairy industry. In this study, sorghum flour is utilized at 2, 3 or 4 % to optimize the product. The blended product at the 3 % (T_2) awarded the sensory scores of 7.6 for colour and appearance, 8.0 for body and texture, 7.63 for flavour and 8.01 for an overall acceptability score, which was higher than that of the control group which has scored 7.55, 7.85, 7.51 and 7.50, respectively. Thus, in comparison to the control group (0.00 mg of iron and fibre), T_2 had 0.06 mg of fibre and 0.16 mg of iron. In contrast, WPC blended at 2 % level paired with 3 % sorghum flour obtained significantly (P d" 0.05) higher overall acceptability score of 8.10 compared to control (8.01) and had higher amount of protein 4.28 % than control 2.71 %.

Key words: Sorghum, Whey protein concentrate, Iron, Fiber.

Introduction

India is the largest milk producing country in the world by producing total of 230.6 MT during 2022-23 (BAHS, 2023). A considerable quantity of milk is being utilized in the manufacturing of milk products. The bioavailability of milk nutrients can be improved by process of fermentation. Lactic acid bacteria used in fermentation helps in eliminating toxins and anti-nutritional compounds available in different food formulations (García-Burgos et al. 2020). Fermented milk products got therapeutic properties due to presence of several viable cells.

India is the world's biggest producer of millet and plays a key role in the world's millet output. Among all **Sorghum** (*Sorghum bicolor*) stands second by contributing 26**%** in major millet production in India (APEDA. 2024). In general sorghum is a rich source of fiber and B-complex vitamins. It provides dietary fiber by 48 % of the recommended daily value (Samarth et al. 2018). The essential amino acids present in WPC makes it an important functional ingredient required for human nutrition (Yiðit et al. 2023). The study suggested developing a delicious, protein-rich sorghum-based dairy product (lassi) by adding sorghum and WPC to cow's milk, aiming to enhance both its nutritional and sensory qualities.

Cow milk was procured from Students Experimental Dairy Plant (SEDP) of Dairy Science College, Hebbal, Bengaluru. Sorghum millets are procured from Bb Royal BB Royal Organic Jowar/ Sorghum Millet. Whey protein concentrate (WPC-80) was procured from Asitis, Medizen Labs Pvt. Ltd, Bengaluru. Standard lactic culture was procured from department of dairy microbiology, Dairy Science College, Hebbal, Bengaluru. Madhur pure and hygienic cane sugar was purchased from local store.

Lassi was prepared by following the procedure of Patel et al. 2020 with suitable modifications. The cow milk of 3.0% fat and 8.5% SNF was heated to 40-45° C and filtered by using muslin cloth to remove extraneous matter from milk. The germinated jowar flour was added to milk at 2, 3 or 4% and heat treatment was done to 85°C for 5 minutes to denaturate whey proteins and to ensure food safety. Further the slurry was cooled to 37°C and inoculated with standard lactic culture at 2% level. Then the slurry was incubated for about 8 hrs till the pH attainment of 4.7 to obtain enriched curd. Breaking of coagulum was done and added with pasteurized chilled water at 20%. To that the sugar was added as a sweetening agent at 10%. Further all the ingredients were mixed to get sorghum blended *lassi*.

Based on the sensory attributes, the optimized level of sorghum was further blended with WPC-80 at 1, 2 or 3% by following the

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above-mentioned procedure in order to obtain the nutritionally rich delicious functional *lassi* and packaging was done in PET bottles and stored under refrigeration temperature (7±1° C).

The sensory attributes of *lassi* were determined by using 9-point hedonic scale by semi-trained panellists of the Dairy science college, Hebbal, Bengaluru based on parameters like, colour and appearance, body and texture, flavour and overall acceptability.

The % moisture content of sorghum and wpc-80 blended *lassi* was determined by gravimetric method as per IS: 1479 (part II) 1961. The protein content was determined by estimating the % nitrogen by Micro-Kjeldahl method as recommended in IS: 1479 (part II), 1961 and the % nitrogen was multiplied by 6.38 to find out protein %age in *lassi*. Standard Gerber method was used for determination of fat content as per IS: 1224 (part I), 1977. The fibre content and the iron content of *lassi* was estimated by AOAC Method No. 985. 35 (AOAC, 2005).

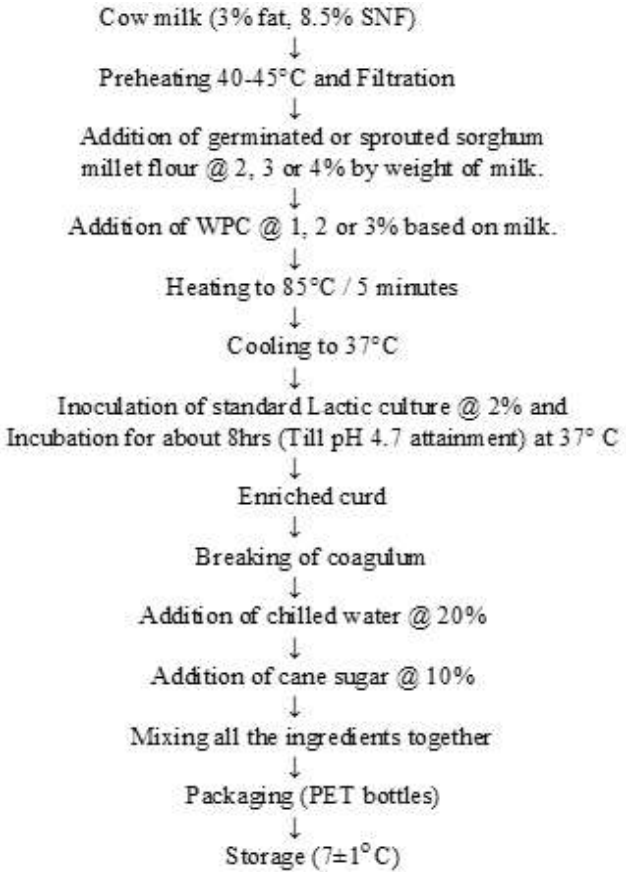

Fig.1 Process flow chart for the manufacture of Sorghum and whey protein concentrate blended *lassi*

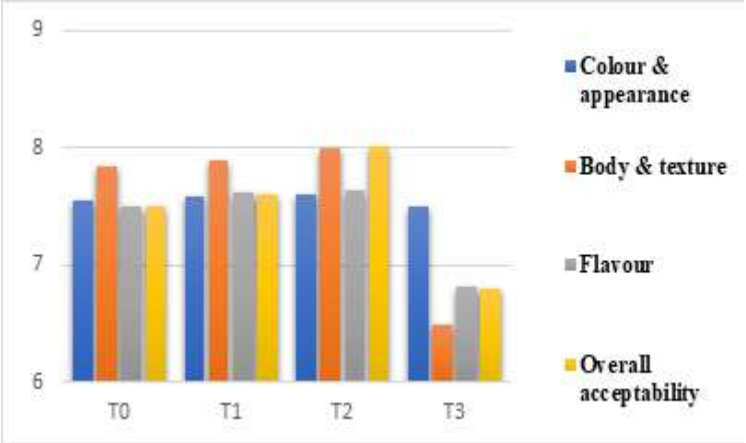

Fig 2: Effect of sorghum on sensory parameters of *lassi*

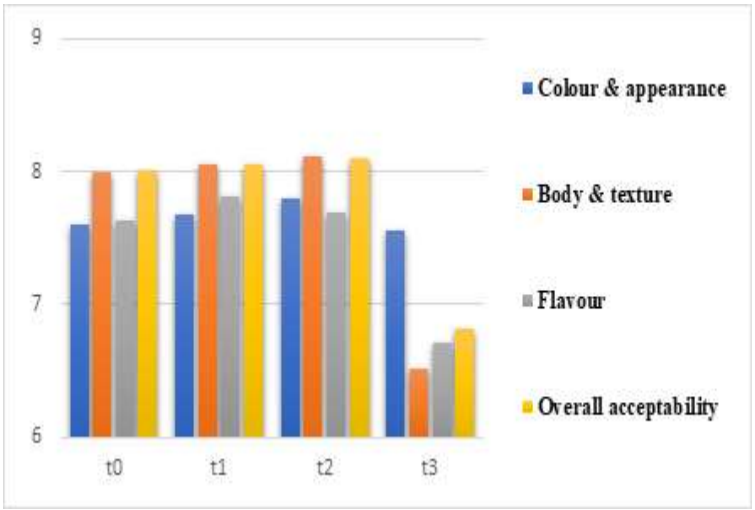

Fig 3: Effect of WPC on sensory parameters of sorghum enriched *lassi*

The data obtained during the research studies was analysed by using R software (R. version 4.0.3) to calculate mean and critical difference to determine significant and non-significant effect of different trails obtained during the study.

The prepared control (T_o) *lassi* and sorghum flour enriched *lassi* at 2% (T_1), 3% (T_2) and 4% (T_3) was analysed for sensory evaluation. For colour and appearance, no significant differences were observed between the treatments (P d" 0.05), with scores ranging from 7.50 for T_3 to 7.60 for T_2. In terms of body and texture, T_2 (3% sorghum flour) scored the highest at 8.00, followed by T_1 (2% sorghum flour) at 7.89. In contrast, T_3 (4% sorghum flour) received the lowest score of 6.50, showing a decline in texture with the higher sorghum flour content. Regarding flavour, T_2 again led with a score of 7.63, while T_3 scored the lowest at 6.81, indicating that higher sorghum flour concentration negatively affected flavour as the panalists observed after taste of sorghum flour beyond 3% level. For overall acceptability, T_2

Table 1: Effect of Sorghum (Great millet) flour on the sensory parameters of *lassi*

Levels of sorghum flour (%)	Colour & appearance	Body & texture	Flavour	Overall acceptability
T_0	7.55	7.85[a]	7.51[a]	7.50[a]
T_1	7.58	7.89[a]	7.62[a]	7.61[a]
T_2	7.60	8.00[a]	7.63[a]	8.01[a]
T_3	7.50	6.50[b]	6.81[b]	6.80[b]
CD ($P \leq 0.05$)	NS	0.45	0.36	0.72

Table 2: Effect of Sorghum (Great millet) flour on the compositional parameters of *lassi*

Levels of sorghum flour (%)	Moisture (%)	Protein (%)	Fat (%)	Fiber (g/100g)	Iron (mg /100g)
T_0	80.90[a]	2.45[b]	2.45	0.00	0.00
T_1	79.16[b]	2.62[ab]	2.43	0.04	0.10
T_2	78.29[c]	2.71[a]	2.42	0.06	0.16
T_3	77.42[d]	2.83[a]	2.40	0.08	0.21
CD ($P \leq 0.05$)	0.36	0.24	NS	NS	NS

Table 3: Effect of WPC on the sensory parameters of Sorghum (Great millet) flour enriched *lassi*

Levels of wpc -80 (%)	Colour & appearance	Body & texture	Flavour	Overall acceptability
t_0	7.60	8.00[a]	7.51[a]	7.50[a]
t_1	7.68	8.05[a]	7.82[a]	7.70[a]
t_2	7.80	8.12[a]	7.69[a]	8.10[a]
t_3	7.55	6.51[b]	6.71[b]	6.82[b]
CD ($P \leq 0.05$)	NS	0.41	0.51	0.72

Table 4: Effect of WPC on the compositional parameters of Sorghum (Great millet) flour enriched *lassi*

Levels of wpc -80 (%)	Moisture (%)	Protein (%)	Fat (%)	Fiber (g/100g)	Iron (mg /100g)
t_0	78.29[a]	2.71[d]	2.42	0.060	0.16
t_1	77.51[b]	3.49[c]	3.11	0.059	0.158
t_2	76.75[c]	4.28[b]	3.12	0.058	0.156
t_3	76.00[d]	4.97[a]	3.13	0.058	0.155
CD ($P \leq 0.05$)	0.21	0.29	NS	NS	NS

received the highest score of 8.01, followed by T_1 with 7.61, while T_3 was the least acceptable by obtaining 6.80. The statistical analysis revealed significant differences in body and texture, flavour, and overall acceptability (P d" 0.05), highlighting that the optimal sorghum flour concentration for the best sensory attributes is around 3%.

By increasing the level of sorghum flour, moisture content of prepared *lassi* was decreased because of increase in total solids content. Sorghum possesses high protein content of 10g/100g (IIMR.2024) hence, the protein content in prepared *lassi* was seen to be increased by increasing the sorghum content. As the milk is devoid of iron and fibre, % of iron and fibre was significantly raised to some extent after enrichment with sorghum flour.

The *lassi* with 3% sorghum flour was kept as a control (t_0) and further enrichment is done by incorporating wpc-80 at 1% (t_1), 2% (t_2) or 3% (t_3) and analysed for sensory evaluation. The organoleptic properties of prepared *lassi* was improved as the brighter color for the wpc-80 incorporated *lassi* was observed by scoring 7.68, 7.8, 7.55 respectively for 1, 2 and 3% than control group which has scored 7.6. Textural properties also were improved by incorporation of wpc upto 2% by raising scores from 8.0 to 8.12 from control to 2% wpc incorporated product. Beyond 2%, the textural scores has been reduced. This may be due to increase in the viscosity (thickness) of the product at 3%. The astringent flavor of wpc was masked by sorghum flour until 2% but beyond that the panalists experienced astringent flavor in the *lassi* as the product was a acidic protein beverage (Carter

et al. 2020). Based on these the obtained overall acceptability scores were 8.01(t_0), 8.05 (t_1), 8.10 (t_2) and 6.82 (t_3). Hence, the panalists optimized *lassi* blended at 2% wpc.

By incorporating the whey protein concentrates, the nutritional value of *lassi* in terms of protein was drastically increased like 2.71(t_0), 3.49(t_1), 4.28(t_2) and 4.97(t_3) along with the fat content. This may be due to the presence of fat content in wpc-80 but there observed the decrease in milk devoid nutrients like fibre and iron.

Conclusions

The developed Sorghum (Great Millet) and Whey Protein Concentrate (WPC-80) blended *lassi* was having high protein content by consuming 200ml of developed *lassi*, a child (4-6 years) can meet around 43% of RDA, an adult male can meet around 14.3 % of RDA and an adult female can meet around 15.5% of RDA of protein. Along with protein the lacuna of iron and fibre in milk products can be significantly fulfilled by blending sorghum and WPC. Intern, enriched *lassi* has great marketing potentiality and contributes for healthy beverage besides consumer satisfaction. Further the scope may exist for the addition of concentrated form of sorghum to raise the nutritional property of the produced beverage.

Acknowledgments

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