OriginalArticle

Comparative analysis on the Iron Concentration of Conventional over Probiotic based Pearl Millet Foods By Atomic Absorption Spectrophotometric Analysis

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Abstract

Aim : To estimate the Iron concentration of probiotic based fermented innovative pearl millet by the atomic absorption spectrophotometry. **Materials and methods**: Pearl millet composition with probiotics was made and fermented for 18 hours. For iron measurement by atomic absorption spectrophotometry, the probiotics Lactobacillus and Bacillus mesentericus were utilized and compared to uninoculated pearl millet. Clincalc.com and the prior web were used to calculate the sample. The alpha error level was set at 0.05 percent, the confidence interval was set at 95 percent, the G power was set at 80 percent, and the enrollment ratio was set at one (N=18). Using IBM SPSS V 28.0 software, T tests were performed between the samples. **Results**: The Iron concentration was estimated to be 2.34 mg/kg for probiotic pearl millet and 3.6 mg/kg for conventional pearl millet. The statistical T test analysis of the results revealed it as insignificant . **Conclusion**: The moderate increase in the Iron concentration of pearl millet can be further standardized for the use as nutritional supplements for the adult population.

Keywords: Innovative Pearl millet, Probiotics, SPSS, Atomic Absorption Spectrophotometry, Milk, Curd, Lactobacillus, Bacillus mesentericus.

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INTRODUCTION

Pearl millet, also known as Bajra, has high protein and iron content (Food and Agriculture Organization of the United Nations et al. 2018). Iron content in the Pearl millet cultivars ranges from 42-79.9 mg/kg. (Velu, Rai, and Sahrawat 2008)Anemia affecting 30%–50% of children and other groups are mostly caused by Iron deficiency (World Health Organization 2007). The marginal increase in the concentration of iron was observed in the fermented Pearl millet products. (Inyang and Zakari 2008). High iron content in pearl millet is used to treat anemia which promotes enhancement of hemoglobin in the body, it is also used to treat constipation. (Chaudhary and Kapoor 1984). Iron is important for practically all living organisms because it is involved in a range of metabolic activities in our bodies, including oxygen transport, deoxyribonucleic acid (DNA) synthesis, and electron transport. (Chaudhary and Kapoor 1984; Abbaspour, Hurrell, and Kelishadi 2014). The mineral iron is used for growth and development. It also carries oxygen to the blood. So it is used to treat many health related malnutrition. (Abbaspour, Hurrell, and Kelishadi 2014)

Literature was searched in accordance to the title in platforms including google scholar, science direct, and pubmed. An average of 727 papers were found in google scholar. Fermentation improves the digestibility of millet protein and decreases the concentration of phytic acid and polyphenols. Fermentation is a process that is practiced to increase the texture, flavor, and palatability of the food (Dias-Martins et al. 2018).The ability of selected lactic acid bacteria to ferment pearl millet produces gruels for complementary foods for young children. (Mouquet-Rivier et al. 2008; Songré-Ouattara et al. 2010).Our team has extensive knowledge and research experience that has translate into high quality publications(Bhansali et al. 2021; Jayanth et al. 2021; Sudhakar, Ravel, and Perumal 2021; Sathiyamoorthi et al. 2021; Deepanraj et al. 2021; Raju et al. 2021; Arun Prakash et

al. 2020; Kamath et al. 2020; Shanmugam et al. 2021; Rajasekaran et al. 2020; Adhinarayanan et al. 2020; Rajesh et al. 2020; Aurtherson et al. 2021)

There have been reports on the use of different probiotics on the fermentation of Pearl millet and their Iron availability, but no data on the combined use of Lactobacillus sporogenes and Bacillus mesentericus and their Iron availability. Thus this work was carried out to study the probiotic therapy affecting the iron content of pearl millet (Turpin, Humblot, and Guyot 2011). The aim of the research is to estimate the amount of Iron concentration in Probiotics based innovative Pearl millet and Conventional Pearl millet. The probiotic strains Lactobacillus and Bifidobacterium are used. The final amount of Iron is estimated by Atomic Absorption Spectrophotometry (Govindaraj et al. 2020).

Materials And Methods

The research was carried out at the Microbiology Laboratory at Saveetha School of Engineering, Saveetha Institute of Medical and Technical science, Chennai.Total number of groups is 2 (Probiotic based Pearl millet and Conventional Pearl millet). The sample size was 18. Pre-test power the sample size was calculated by clincalc.com. alpha error- threshold at 0.05, confidence interval at 95%, g power at 80% and enrolment ratio at 1 (Mahendrakar et al. 2020).
About 20g of powdered pearl millet was combined with 200 mL of Milk and steam sterilized for 20 minutes at 121°C. To this pearl millet composition, pure culture of *Lactobacillus sporogenes*and *Bacillusmesentericus*isolated in MRS agar was inoculated and the uninoculated composition served as a comparative control (Mahendrakar et al. 2020).
Iron concentration was estimated by Atomic Absorption Spectrophotometry for the Probiotic based Pearl millet and Conventional Pearl millet following the standard procedure (Abbey and Geological Survey of Canada 1968).

Statistical Analysis
Statistical analysis was calculated by IBM SPSS version 28 software. There were no independent variables; the Probiotic treated Pearl millet and Conventional Pearl millet are the dependent variables. Paired T test; standard deviation in standard of mean errors was performed using IBM SPSS version 28 (Mahendrakar et al. 2020).

Results

The Iron concentration was estimated by Atomic Absorption Spectrophotometry. The concentration values estimated to be for 2.34 mg/kg for Probiotic Pearl millet and 3.6 mg/100g for Conventional Pearl millet and its divergent values were summarized in Table 1, Fig. 1 and Fig. 2.
Table 2 represents the paired T test analysis which was statistically insignificant between the Probiotic based pearl millet and conventional pearl millet diet composition and are represented in Fig. 3.
Table 3 represents the mean±standard error variation between the probiotic based pearl millet and conventional pearl millet. Pearl millet and Conventional Pearl millet. Iron observed in the Probiotic based Pearl millet samples in our study. Our results were inconsistent with the iron concentration of the pearl millet analyzed in their region showing higher concentration here is a moderate decrease in the iron concentration of probiotic treated pearl millet. Our results were inconsistent with the Iron concentration of the pearl millet analyzed in their region.

Discussion

The iron concentration was estimated to be 2.34 mg/kg for probiotic treated pearl millet and 3.6mg/kg for conventional pearl millet. There is a moderate decrease in the iron concentration of probiotic treated pearl millet. Our results were inconsistent with the Iron concentration of the pearl millet analyzed in the other geographical regions.
The probiotic-based pearl millet composition employed in this study is a unique preparation in which Milk was used as an extra substrate and *Lactobacillus sporogenes* and *Bacillus mesentericus* were used as microorganisms (Arora, Jood, and Khetarpaul 2011). In order to understand the impact of these microorganisms on concentration with and without fermentation, full sterilization was also carried out. According to Gabbaza the Iron bioaccessibility of fermented millets shows the evaluation of iron to be 3.22 mg/kg for fermented pearl millet (Gabaza et al. 2018) which is similar to our study. Aparna study states that Iron concentration is estimated as 5.1 mg% for fermented millets which was found to be higher concentration than our research values. (Aparna et al.

2017). Probiotic fermented millets had shown an increase in the Iron concentration from 18.1 to 37.5 which is comparatively higher than our research. (Budhwar, Sethi, and Chakraborty 2020).
In our study,sample was analyzed after 18 hours of fermentation at 37 degree Celsius .The usage of lactic acid bacteria decreases phytic acid, allowing for a higher concentration of iron to be available, and the fermentation process may aid in food digestion (Arora, Jood, and Khetarpaul 2011). Thus further standardization of temperature,PH,and Inoculum size of the microorganisms could aid in the increased bioavailability of iron for iron-deficient people.

Conclusion

The concentration of accessible nutrients could be increased by fermenting and preparing Pearl millet. Our research found that the iron concentration ranged from 2.34mg/kg to 3.6mg/kg and that further optimization could aid in the creation of probiotic-based pearl millet diets. As a result, the unique technique of using *Lactobacillus sporogenes* and *Bacillusmesentericus* as probiotics in the innovative pearl millet composition, as well as their involvement in fermentation, has to be investigated further.(Charalampopoulos et al. 2002),

Declaration

Conflict of interest
No conflict of interest in these manuscripts.
Authors contribution
Author BP was involved in data collection, data analysis, manuscript writing, Author SS was involved in conceptualization, data validation, and critical review of manuscript.
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Figures And Tables

Table 1. Iron concentration of Probiotic treated Pearl millet and Conventional Pearl millet and its different values.

Probiotic treated Pearl millet in mg	Conventional Pearl millet in mg
2.34	3.6
2.25	3.2
2	3
1.87	2.8

1.76	2.5
1.64	2.3
1.45	2
1.33	1.9
1.16	1.5

Table 2. Iron concentration values of Probiotic based pearl millet and Conventional pearl millet and its different values were summarized.C

Group Statistics					
	GROUP	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
IRON CONCENTRATION	PROBIOTIC BASED PEARL MILLET	10	1.9400	0.69628	.22018
	PEARL MILLET	8	2.4000	0.58554	.20702

Table 3. Paired T test analysis between the Probiotic based Pearl millet and conventional Pearl millet food composition .

		Levene's Test for Equality of Variances		**t-test for Equality of Means**							
		F	**Sig.**	**t**	**df**	**One sided significance**	**Two sided significance.**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
										Lower	**Upper**
IRON CONCENTRATION	Equal variances assumed	.003	.955	-1.492	16	.078	-155	-46000	30840	-1.11377	.19377

	Equal variances not assumed			-1.522	15.935	.078	.148	-46000	.30222	-1.10089	.18089

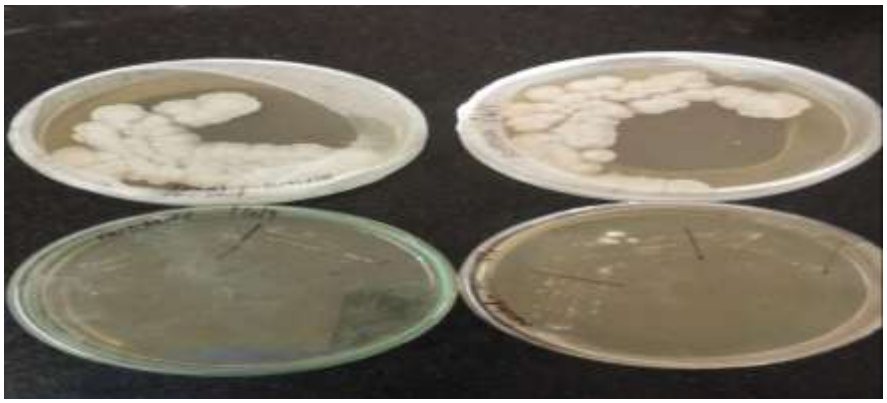

Fig. 1. Bifidobacterium and Lactobacillus cultured from curd and bifilac sachet as Probiotic strains

Fig. 2. Beakers containing fermented pearl millet and milk. The fermentation time is 18 hrs

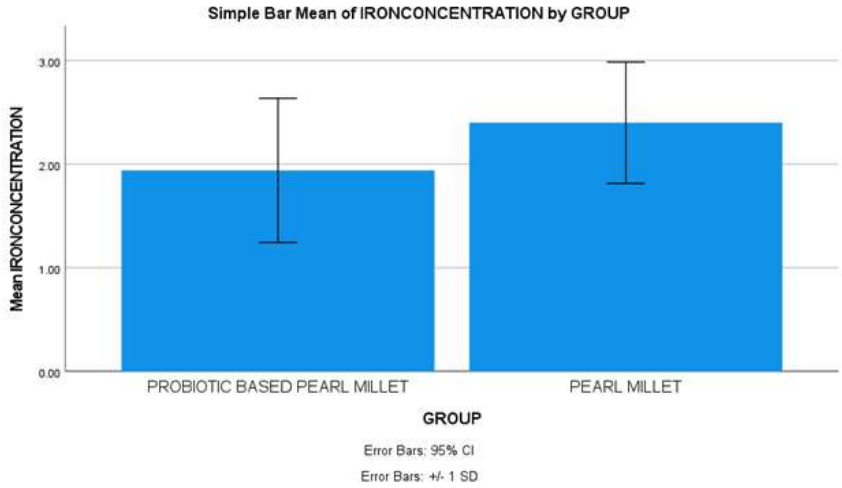

Fig. 3. Probiotic based Pearl millet shows significant decrease when compared to the Conventional Pearl millet (P<=0.001). X-axis represents the probiotic based pearl millet and pearl millet, and Y-axis indicating the mean iron concentration. SD+/- 1.