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Formulation, Standardization, and Quality Analysis of Ready-to-Cook Foxtail Millet (*Setaria italica*)

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Abstract

This study introduces a ready-to-cook (RTC) foxtail millet product to meet the demand for convenient and nutritious dietary options. Various treatments (T_1 to T_{15}) were applied, including boiling, pressure cooking, and straining, with T8 emerging as the preferred variant with an average hedonic scale score of 8.84±0.45. This variant underwent freeze-drying. Physical parameters of raw millet and cooked millet properties were analyzed, along with characteristics of the RTC millet such as color analysis, rehydration ratio, and volume expansion. Proximate composition analysis revealed that the final product had reduced moisture (8±0.03%) and fat (0.8±0.12g), increased protein (12.8±0.67g) and crude fiber (6.4±0.03%), with carbohydrates at 72±0.26g per 100 grams. Vitamin B1 and B2 levels slightly decreased, while calcium and iron showed minor reductions. Antinutrients were significantly reduced. Microbial analysis indicated the effectiveness of freeze-drying, and a 60-day shelf-life assessment revealed a gradual increase in bacterial count but within consumable limits. Sensory analysis favored treatment R3 (Rehydrated RTC millet) with a mean score of 8.66±0.6. Paired comparison with traditionally cooked millet confirmed the superiority of RTC millet (R_3). This study highlights the potential of RTC foxtail millet, demonstrating its adaptability, nutritional profile, and consumer appeal. Freeze-drying effectively preserves product quality, offering a promising solution for accessible and health-conscious food alternatives.

***Key words*:** Foxtail millet, Ready-to-Cook product, Freeze-drying technology, Nutritional density

The culinary landscape has undergone a profound transformation, marked by a discernible surge in convenience foods to meet the demands of rapidly urbanizing societies. Millets, recognized for their nutritional prowess, play a pivotal role in this culinary renaissance, seamlessly integrating into an array of convenience foods such as puffed and flake millets, pasta, noodles, and baked products [21]. Belonging to the Poaceae family, millets encompass several varieties characterized by proteins serving as excellent sources of essential amino acids. Beyond nutritive value, millets have gained recognition for potential health benefits, including wound healing enhancement, cardiovascular disease prevention, and the reduction of blood glucose and cholesterol levels [7]. Scientific investigations highlight the presence of antioxidants like carotenoids, phenolics, and tocopherols in millets, elevating their status as invaluable food sources. Moreover, millets stand out as sustainable crops, particularly in arid regions with limited water supply. Global millet production in 2016 reached approximately 28 million tons, with Africa and Asia contributing 48% and 47%, respectively [15]. Among millet varieties, foxtail millet holds a prominent position due to its gluten-free composition and rich nutrient profile. With a moderate glycemic index, high fiber content, and essential nutrients, foxtail millet offers tangible benefits for diabetes prevention, cardiovascular health, weight management, and overall well-being [19].

This aligns seamlessly with the global shift towards health and sustainability, as seen in the Lifestyles of Health and Sustainability (LOHAS) segment. Consumers actively seek healthy, high-quality, and sustainable products, and the clean label trend, emphasizing natural or organic ingredient sourcing, further underscores the significance of millets in the ever-evolving food landscape [8]. The convergence of health-conscious and sustainable consumer preferences finds resonance in India's Ready-to-Cook (RTC) market, reflecting substantial shifts in food consumption patterns.

Within the multifaceted realm of convenience foods, a nuanced dichotomy emerges, classifying these culinary offerings into two primary categories: ready-to-eat and ready-to-reconstitute foods [29]. The Defence Food Research Laboratory (DFRL) in Mysore emerges as a pioneering force in food technology, particularly in the preservation of traditional Indian foods. The laboratory's innovative use of lightweight flexible packaging not only extends shelf life but also results in the creation of ration packs tailored to meet the diverse nutritional needs of Defence personnel during operational scenarios [29]. In doing so, the Defence Food Research Laboratory (DFRL) has not only revolutionized military sustenance but has also paved the way for a diverse array of convenient and nutritionally fortified food options that align seamlessly with individual preferences and dietary requirements.

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The introduction of ready-to-cook foxtail millet products showcases their versatility in various critical scenarios, including space food, military rationing, and during natural calamities. Their lightweight, nutrient-dense nature makes them an ideal solution for astronauts' nutritional needs in space, providing convenience and extended shelf life. In military settings, these products offer practical, easy-to-prepare alternatives, catering to the nutritional requirements of personnel during operations. During natural disasters, millet-based RTC products provide a reliable, nutritious resource with an extended shelf life, addressing food challenges in emergency relief efforts. This study explores the potential of millets in these critical scenarios, emphasizing their adaptability and nutritional value. The main objective of this study is to:

- To Formulate a Ready to Cook foxtail millet
- To evaluate the physical properties of the raw, cooked and RTC product and nutrient composition of the raw and RTC product.
- To investigate the microbial, shelf life and sensory analysis of the product.

MATERIALS AND METHODS

Formulation of RTC foxtail millet

The SIDDHA CENTRAL RESEARCH INSTITUTE certified the raw material, *Setaria italica* with code of S060224081.The procured foxtail millet undergoes a thorough washing 2-3 cycles to eliminate impurities. Subsequently, a controlled roasting process is implemented, subjecting the millet to high temperatures (100°C) for 10 minutes. Following the pretreatment, the cooking process employs three distinct methods: pressure cooking, known for its efficiency in reducing cooking times; straining, involving immersion in 100°C water and subsequent removal of excess water; and boiling, which maintains 100°C water immersion until the desired tenderness is achieved.

Standardization of cooked foxtail millet

In the standardization process of cooked foxtail millet, three distinct cooking methods were employed: Pressure cooking (121°C) with a millet-to-water ratio of 1:3, Straining (100°C) with a ratio of 1:5, and Boiling (100°C) with a ratio of 1:4. These methods involved varying cooking durations, resulting in the formulation of treatments ranging from 1 to 15 (Table1). The comprehensive evaluation involved 30 non-trained assessors, assessing color, appearance, texture, flavor, taste, and overall acceptability of these treatments.

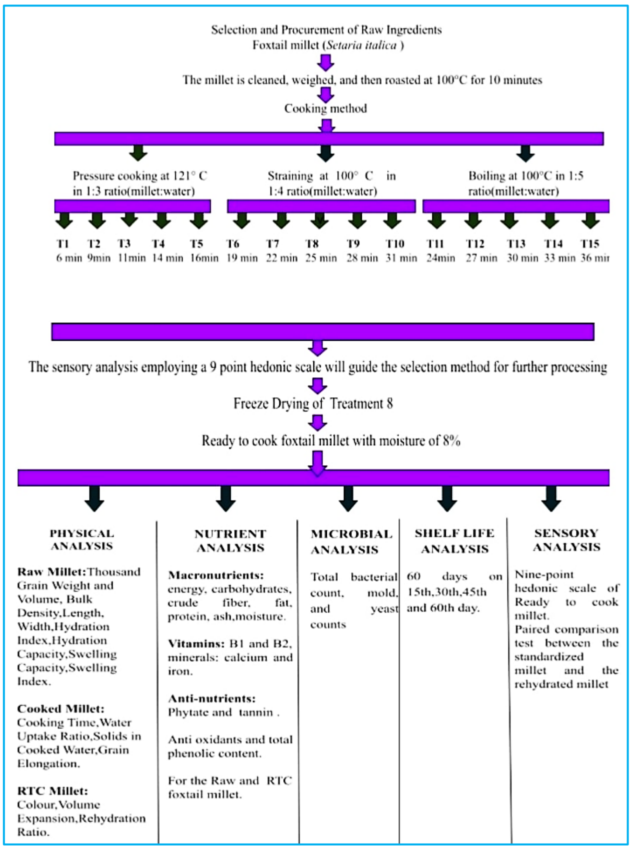

Fig 1 Methodology followed for the study

Treatment of the standardized cooked foxtail millet

After standardized cooking, millet undergoes freeze-drying at -60 to -30 degree Celsius for 36 hours. Freezing, expedites dehydration and contributes to the development of porous structures in the millet product. This enhancement improves the rehydration capacity of the final product [14], [17-18]. The dehydration process continues until the millet achieves a targeted moisture content of 8% [27].

Table 1 Variation of different cooking methods

Millet	Pre-treatment (100°C For 10 Minutes)	Cooking Method	Time (Minutes)	Treatment	Temperature	Millet : Water
Foxtail millet	Roasting	Pressure cooking [40]	6	T1	121°C	1:3
			9	T2		
			12	T3		
			15	T4		
			18	T5		
Foxtail millet	Roasting	Straining [31]	19	T6	100°C	1:5
			22	T7		
			25	T8		
			28	T9		
			31	T10		
Foxtail millet	Roasting	Boiling [10]	24	T11	100°C	1:4
			27	T12		
			30	T13		
			33	T14		
			36	T15		

Physical analysis of raw, cooked and RTC foxtail millet

Assessment of Raw foxtail millet involved measuring length,width, thousand grain weight, volume, bulk density, hydration capacity, and index, Swelling capacity and index. Cooked millet was evaluated for cooking time, water uptake ratio, solids in cooking water, and grain elongation. Ready-to-Cook (RTC) millet underwent analysis for rehydration ratio, volume expansion, and color using Hunter colrimeter [16].

Nutrient analysis of raw and RTC foxtail millet

The nutrient analysis of both raw and Ready-to-Cook (RTC) foxtail millet included the assessment of proximate composition, including energy, carbohydrates, protein, fat, crude fiber, ash, and moisture content. Additionally, the analysis encompassed Vitamin B1 and B2, antinutrients such as tannins and phytate, mineral composition including iron and calcium, as well as DPPH activity and total polyphenols [6].

Microbial analysis of RTC foxtail millet

Total Bacterial count, yeast and Mold count of Ready to cook foxtail millet was assessed.

Sensory analysis of RTC foxtail millet

For assessing the acceptability of the rehydrated Ready-to-Cook millet, a nine-point hedonic scale was employed. Additionally, a paired comparison test was conducted, comparing the traditionally cooked millet with the rehydrated millet.

Shelf-life analysis

The shelf life of the RTC foxtail millet will be evaluated over a period of 60 days (0th, 15th, 30th, 45th, and 60th days) at room temperature.

RESULTS AND DISCUSSION

Formulation of ready to cook foxtail millet

Treatment 8, employing the straining method with a 1:5 millet water ratio, stood out, requiring approximately 28 minutes to achieve the desired texture. These findings, emphasize the consumer preference for conventional cooking methods, such as boiling, over pressure cooking for rice [2].

Physical properties

Raw millet grain

The physical properties of raw millet grain are given in (Table 2).

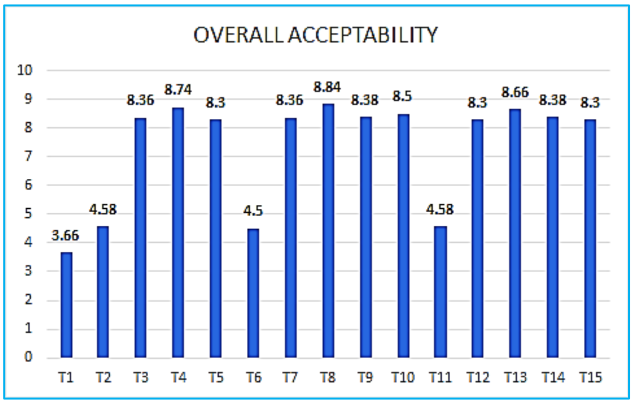

Fig 2 Estimation of overall acceptability

Thousand grain weight (g)

The thousand grain weight of foxtail millet was found to be 4.22g, consistent with previous findings [30], which reported a similar weight of 4.15g.

Table 2 Physical properties of raw foxtail millet grain

Physical properties		Value
Thousand grain weight		4.22 ± 0.1g
Thousand grain volume		6.22 ± 0.04ml
Bulk density		0.67 ± 0.06g/ml
Hydration capacity		2.01 ± 0.02g
Hydration index		76.9 ± 0.05%
Swelling capacity		0.2 ± 0.02g
Swelling index		6.72 ± 0.45ml
Size	Length	3.22 ± 0.1mm
	width	2.31 ± 0.1mm

Thousand grain volume (ml)

The thousand grain volume for foxtail millet was measured at 6.22ml, showing a variance of 2ml compared to the study [30], where it was reported as 4.20ml.

Bulk density (g/ml)

Foxtail millet exhibited a bulk density of 0.67 g/ml, which aligns with the reported value of 0.68 g/ml [30].

Hydration capacity (g) and hydration index

The hydration capacity was determined as 2.01±0.02g, with a hydration index of 76.9±0.05%. This differs from the reported value of 2.53g [3], showcasing a variation of 0.52, likely attributed to different millet varieties and growth conditions.

Swelling capacity (ml) and swelling index

Foxtail millet exhibited a swelling capacity of 0.2±0.02g and a swelling index of 6.72±0.45%. These values are similar to [3] findings, with a reported swelling capacity of 0.2±0.04g and a swelling index of 3.33±0.45.

Size

The measured length and width of foxtail millet grains were 2.35mm and 1.52mm, respectively. In comparison, [3] reported a length of 3.22mm and a width of 2.31mm, reflecting a 1mm difference, possibly influenced by millet variety and environmental factors.

Cooked millet grain

The physical properties of cooked millet grain are elaborated in (Table 3).

Table 3 Physical properties of cooked foxtail millet grain

Physical properties	Value
Cooking time	11 minutes
Water uptake ratio	250%
Solids in cooking water	2.4%
Grain elongation	5%

Cooking time

Foxtail millet exhibited a cooking time of 11 minutes per 15g, aligning closely with the findings which reported a similar cooking time of 11.66±0.57 minutes [33].

Water uptake ratio

The water uptake ratio for foxtail millet was measured at 250%, slightly higher than the reported value of 245% [33].

Solids in cooking water

The evaluation of solids in cooking water for foxtail millet grains revealed a content of 2.4%, consistent with the reported value of 2.5% by [33].

Grain elongation

Foxtail millet exhibited a grain elongation of 5%, surpassing the reported value of 4.5% [33]. This suggests a higher elongation potential in the present study.

Ready to cook millet

Color analysis

The Color analysis of RTC millet shown in (Table 4) where L* value, representing lightness, was higher in the ready-to-cook millet, while b* (yellowness) was lower, possibly due to the loss of yellow pigments during cooking. The a* value, indicating redness, was higher in the ready-to-cook millet. The freeze-drying process contributed to maintaining color fidelity, ensuring visual characteristics were retained effectively [28].

Volume expansion

Rehydrated freeze-dried millet demonstrated a significant volume expansion of 2.99 ml, showcasing the water absorption capacity during rehydration. This expansion reflects the swelling of millet grains due to water uptake, emphasizing the effectiveness of the rehydration process.

Table 4 Proximate composition

Parameters	RAW millet	RTC millet	P value	Significance
Energy (kcal)	368 ± 0.43	346.4 ± 0.84	0.002	S**
Protein (g)	12.98 ± 0.33	12.8 ± 0.67	0.1	NS
Carbohydrates (g)	63.2 ± 0.07	72 ± 0.26	0.4	NS
Fat (g)	2.98 ± 0.05	0.8 ± 0.12	0.2	NS
Crude fiber (g)	4.9 ± 0.04	6.4 ± 0.03	0.14	NS
Ash %	2.1 ± 0.67	2.34 ± 0.05	0.71	NS
Moisture %	15 ± 0.15	8 ± 0.03	0.47	NS

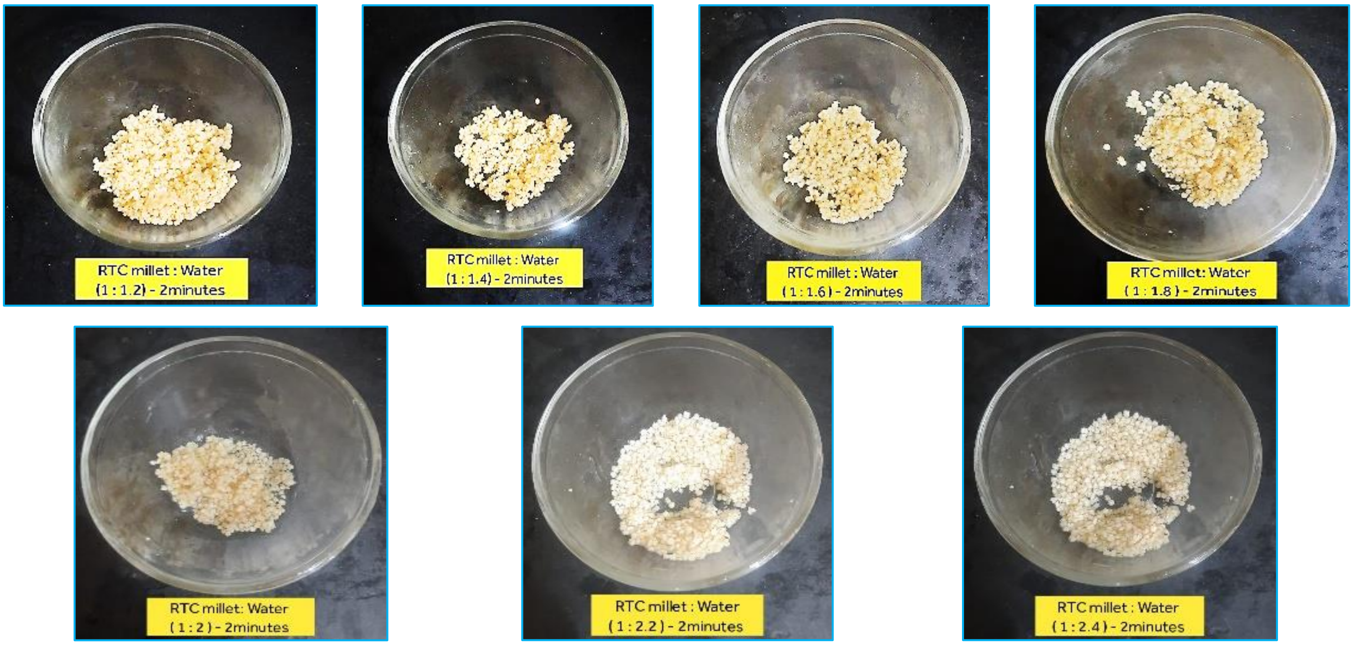

Fig 3 Rehydration capacity of RTC millet

Rehydration ratio

The study systematically assessed rehydration ratios across various millet-to-water treatments. Rehydration capacity is commonly used as qualitative indicators for dried foods [24]. An ascending trend from Treatment R1 (1:1.2) to R7 (1:2.4) indicates proportional water absorption. Optimal millet-to-water ratios are crucial for desired rehydration, impacting texture and palatability. Higher ratios improve quality, while lower ratios may affect final texture. Treatment R3 (1:1.6), which aligns closely with findings from [27], where instant foxtail millet khichdi was reconstituted with a reconstitution ratio of instant mix to water at 1:1.8. The slightly higher amount of water for the instant khichdi can be attributed to the other ingredients present in them in comparison to Ready-to-Cook (RTC) millet. This suggests that higher ratios contribute to enhanced water absorption, potentially improving the quality of the final product, supporting the alignment of findings across studies.

Table 5 Vitamin B composition

Vitamins	Raw millet	RTC millet	P value	Significance
Vitamin B_1 (mg)	0.59 ± 0.92	0.563 ± 1.22	0.71	NS
Vitamin B_2 (mg)	0.78 ± 0.35	0.569 ± 0.24	0.7	NS

Nutritive value

The proximate composition of foxtail millet reveals significant variations in nutritional attributes between its raw and ready-to-cook states is given in (Table 5). The total energy value for raw millet grain is 368±0.43 kcal, while ready-to-cook foxtail millet is 346.4±0.84 kcal. The carbohydrate content of raw millet grain was found to be 63.2 ± 0.07g, while ready-to-cook millet showed a higher value of 72± 0.26g. This increase aligns with findings [34] where significant rises in carbohydrate content were reported, particularly with pre-treatment.

Foxtail millet stands out for its carbohydrate composition, constituting 60-70% of dry matter, primarily in the form of starch. Notably, this millet variety is rich in resistant starch (RS), a nutritional feature linked to delaying gastric emptying and reducing postprandial blood glucose levels. The application of various cooking methods, including boiling, roasting, and shallow frying, has been observed to enhance the content of resistant starch [32].

The protein content of raw millet is found to be 12.98± 0.33g, and for ready-to-cook millet, it is 12.8± 0.67g. No significant difference in protein content is observed between the two states. The finding aligns with the known benefits of freeze-drying, where the process enhances protein retention [38].

The raw foxtail millet grain exhibited a fat content of 2.98g ± 0.05, while the ready-to-cook millet demonstrated a reduced fat content of 0.8±0.12 g. This significant reduction is attributed to fat oxidation and degradation during processing. These findings are consistent with [34], which reported maximum fat reduction in cooked, dried, and roasted grains (2.71 g), followed by roasted grains (4.22 g). The decrease in fat content during cooking is likely due to chemical and physical changes occurring in fat during cooking. The variation in fat content loss across different methods may result from differences in the loss of volatile components due to fat hydrolysis influenced by available water and temperature variations during cooking [12].

The fiber content of raw millet grain was 4.9±0.04g, while ready-to-cook millet exhibited a slightly higher value of 6.4 ± 0.03%. It is plausible that thermal processing may have led to the production of Maillard reaction products, thereby increasing its insoluble dietary fiber value [9]. Similar findings are reported, where significant rises in crude fiber content were observed with pre-treatment (roasting) [34].

Ash analysis is employed to determine the total mineral content available in the food. The ash content of the raw grain is measured at 2.1±0.015%, and for ready-to-cook millet, it is 2.34±0.05%. No significant difference was observed in ash content between the two.No significant difference is observed in ash content between the two states. The slight increase in ash content is due to moisture reduction in millet, which increases the dry matter concentration.The moisture content of raw foxtail millet grain was 15 ± 0.15%, while for ready-to-cook millet, it was 8 ± 0.03%. A significant reduction in moisture content is observed, likely due to the evaporation of moisture during roasting and freeze-drying. Similar findings were reported, highlighting that the reduction in moisture in foxtail millet was attributed to the use of roasting as a dry heat processing method [24].

Vitamin B_1 and B_2 composition

The Vitamin B1 and Vitamin B2 of Raw and RTC foxtail millet is given in (Table 5).

Vitamin B_1

The Vitamin B1 content in raw millet is reported as 0.59±0.92 mg, with a slightly lower content of 0.563±1.22 mg in Ready-to-Cook millet. This observed reduction of 0.027mg in thiamine levels can be attributed to losses during the cooking process.

Vitamin B_2

The Vitamin B2 content in raw millet grain is 0.78±0.35mg, compared to ready-to-cook millet's 0.569±0.24mg, indicating a reduction of 0.21mg, likely attributed to processing methods such as roasting and cooking. Vitamin B2, or Riboflavin, exhibits relative stability to heat [20], with low Riboflavin losses (12–15%) during heat processing [35]. Vitamin B2 exhibits a significantly higher degree of aromaticity compared to B1 and B6, contributing to its stability. Varied cooking methods also play a role; boiling, stewing, frying, and baking incur only a 5% Riboflavin loss.

Mineral composition

The calcium and Iron content of raw and RTC foxtail millet is given in (Table 6).

Calcium

The calcium content of the raw millet grain is 32.42± 0.45, and for Ready-to-Cook Foxtail Millet, it is 30 ± 1.12 mg. show significant variations in calcium content among differently pre-treated millet grains, the maximum reduction was observed in cooked, dried, and roasted grains. This reduction may be attributed to the leaching of nutrients during processing [34].

Table 6 Mineral composition of raw and ready to cook millet grains

Minerals	Raw millet	RTC millet	P value	Significance
Iron (mg)	5.75 ± 0.04	4.63 ± 0.04	0.55	NS
Calcium (mg)	32.42 ± 0.45	30 ± 1.12	0.33	NS

Iron

The iron content of raw millet is measured at 5.75±0.04 mg, while for ready-to-cook foxtail millet, it is 4.63±0.04 mg. No significant changes are observed between the raw and ready-to-cook millet, minor loss potentially occurring during the cooking process. Freeze drying acts as a valuable preservation method, helping to maintain the iron content in the freeze-dried product.

Total polyphenols and DPPH activity

The total polyphenol content in raw millet is 28.87 ± 1.03 mg, showing a substantial decrease to 0.810 mg in ready-to-cook millet. This reduction suggests a significant decline in polyphenol content following cooking, drying, and roasting [34], likely due to the thermo-labile nature of polyphenols [5]. The freezing process induces crystallization, leading to changes in intercellular spaces, impacting electrolyte concentrations and causing the release of enzymes, acids, and other substances. These localized changes in pH and conductivity throughout frozen millet may contribute to the degradation of vitamins and other active components [39]. Furthermore, foxtail millet grains, known for their phenolic-rich composition, exhibit antioxidant properties. The DPPH activity in raw millet is measured at 39%, while in ready-to-cook millet, it decreases significantly to 9.3%. This reduction is likely attributed to the thermo-labile nature of polyphenols and antioxidants, which may have been lost during the cooking process [5].

Antinutrients

Tannins

Tannins, known for forming complexes with proteins and affecting food efficiency, growth, and iron absorption, can have detrimental effects if consumed excessively. Maintaining tannin levels below a safe threshold is crucial to prevent damage to the gastrointestinal tract and eliminate specific tissues, proteins, and essential amino acids [1]. In raw millet, the reported tannin content is 0.36±0.010 mg, while in ready-to-cook millet, it decreases to 1.05µg. This reduction is attributed to cooking and pretreatment methods, particularly roasting, which has shown a significant 74.6% decrease in tannin levels, as, indicating effective tannin elimination through roasting [21].

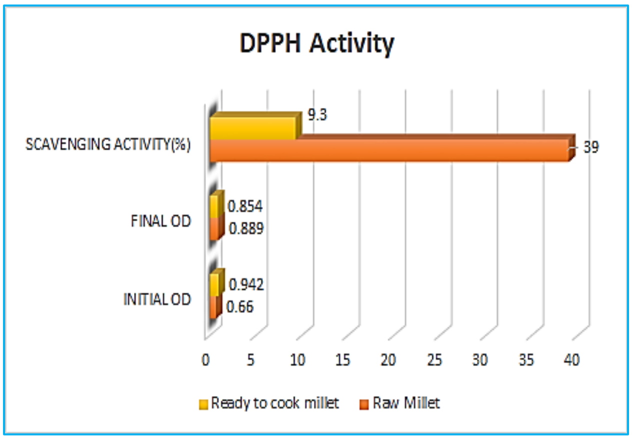

Fig 4 DPPH activity of raw and RTC millet

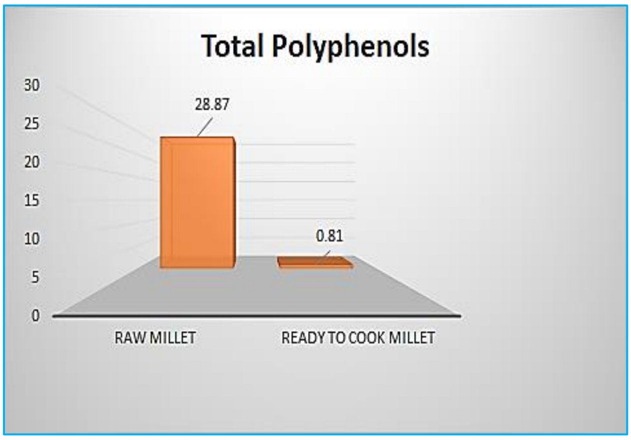

Fig 5 Total polyphenol of Raw and RTC millet

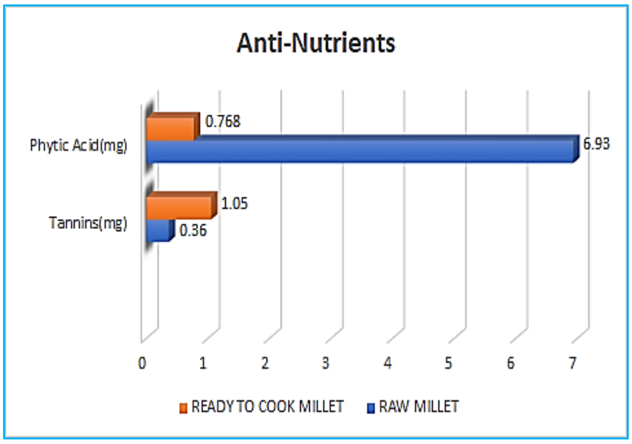

Fig 6 Anti nutrients of raw and RTC millet

Phytate

Phytate, functioning as a secondary metabolic compound, serves as a nutrient reserve in seeds accumulated during ripening. However, humans lack the ability to absorb or hydrolyze phytate, contributing to its role in reducing the bioavailability of minerals. Operating as a negatively charged ion, phytate influences pH-sensitive areas and negatively impacts the bioavailability of positively divalent and trivalent mineral ions such as Zn^{2+}, $Fe^{2+/3+}$, Ca^{2+}, and Mg^{2+}. In raw millet grain, the phytate content is reported as 6.93±0.07 mg, while in ready-to-cook millet, it decreases significantly to 0.768±0.42 µg. Roasting has been found to reduce phytate by 28.4%, and cooking leads to a more substantial reduction of 75.8% [1].

Microbial quality

Microorganisms significantly influence the shelf life of food products, contributing to spoilage. A high aerobe count indicates increased microbial presence, impacting food staling properties. Yeast and mold count are crucial parameters associated with spoilage in various food items. In the microbial examination of ready-to-cook millet, the absence of bacterial, yeast, and mold growth is attributed to the reduced water activity achieved through the freeze-drying process, establishing it as an effective preservation method. Freeze-drying not only prevents microbial proliferation but also extends the shelf life and enhances overall product quality.

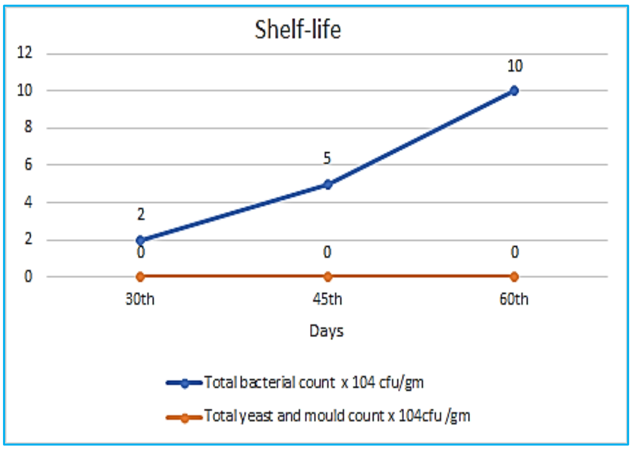

Fig 7 Shelf-life Analysis of RTC Foxtail millet

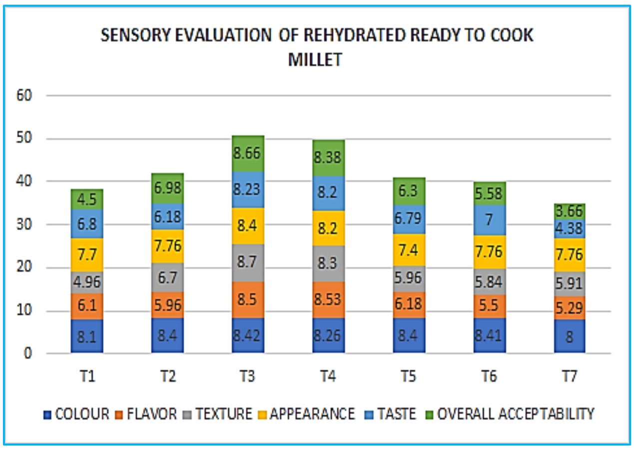

Fig 8 Sensory evaluation of RTC millet

Shelf-life analysis

Microorganisms, in a healthy growing state, derive over 80% of their water from the food they inhabit. Removing water from the food disrupts the microbial cells' water supply, halting their multiplication. Bacteria and yeasts typically require more moisture than molds, making semi-dry foods conducive to mold growth rather than bacteria and yeasts. In the microbial examination of ready-to-cook foxtail millet at room temperatures on the 0th, 15th, 30th, 45th, and 60th day, yeast and mold counts were initially nil (0 day and 15th day). The total bacterial count gradually increased from the 30th day, while yeast and mold growth remained undetectable. Freeze-drying significantly enhanced the product's shelf life by reducing its moisture content, a critical factor in determining shelf life.

Sensory analysis

The rehydration capacity of ready-to-cook foxtail millet across different ratios (R1 to R7) was evaluated using a 9-point hedonic scale Significant differences were observed in sensory parameters among the ratios, with R3 standing out as the most favorable treatment, garnering higher mean scores for color, taste, texture, appearance, and overall acceptability (8.42±0.45, 8.23±0.66, 8.4±0.63, 8.7±0.59, 8.66±0.6, respectively). These scores indicate that R3 was preferred by the panelists in terms of color, taste, texture, appearance, and overall acceptability, suggesting that this ratio provides the most satisfactory rehydration capacity for ready-to-cook foxtail millet.

In a paired comparison test with Rehydrated Ready to Cook Millet (R3) and Traditionally Cooked Millet (T8) [Table 7], R3 consistently emerged as the preferred choice, particularly for taste and flavor. These findings suggest that R3 offers a more appealing and desirable sensory experience, aligning closely with the envisaged flavor and texture profiles for the target product.

Cost analysis

The cost of producing RTC millet was analyzed methodically. RTC foxtail millet costs 167 rupees per 100g, while commercial products like Pongal mix and kichadi mix cost 80 rupees per 100g due to advanced processing techniques. Despite the initial higher cost, bulk production can reduce processing costs, making RTC millet more economically viable. This investment in processing renders RTC millet nutrient-dense, potentially broadening its accessibility despite being initially more expensive. Despite the initial higher cost, it is anticipated that bulk production could significantly reduce processing costs, making RTC millet more economically viable in the long run. The investment in advanced processing methods not only enhances the nutrient density of RTC millet but also has the potential to broaden its accessibility and appeal to a wider consumer base, even though it is initially more expensive. This nutrient-dense characteristic of RTC millet can justify its higher cost, especially for consumers seeking high-quality, health-oriented food products.

Ethical consideration

This study entitled "Formulation, Standardization and Quality analysis of Ready to cook foxtail millet (*Setaria italica*)" has been approved by the Institutional Human Ethics Committee (IHEC) with the protocol no SDNBVC/IHEC/2023/16 - conducted on 20/11/ 2023, by the Department of Home Science-, S.D.N.B. Vaishnav College for women, Chromepet, Chennai-44.

CONCLUSION

The formulation of Ready-to-Cook foxtail millet resulted in a nutritional powerhouse, showcasing preserved essential nutrients through meticulous freeze-drying. This process not only extended the shelf life by effectively reducing microbial activity but also maintained the product's sensory attributes. The nutrient density, combined with an extended shelf life, positions ready-to-cook foxtail millet as a promising and valuable addition to the market, aligning with modern consumers' preferences for convenient, healthy, and flavorful dietary choices.

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