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PHYSICOCHEMICAL ANALYSIS OF DEHYDRATED FOXTAIL MILLET MILK POWDER

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Abstract: India being the primary producer of millet, has less millet-based products available in the market. Their properties make them highly suitable for being use in food-industry and development of value-added food products. Therefore, this study utilizes millet milk powder and the physicochemical properties of the powder was evaluated. Foxtail millet was soaked for 8 hours in water (1:3 w/v) and foxtail millet milk was obtained. It was dried overnight in hot air oven at 50℃ and made into fine dehydrated foxtail millet powder (DFMP). In this study, various physicochemical properties such as total protein, total fat, pH etc. have been analysed according to AOAC methods. An average of 7 g of DFMP was obtained from 100 g of whole foxtail millet. The parameters analysed are pH (6.24), bulk density (0.5 g/m3), protein content (7%), carbohydrate (55g/ 100 g), particle size was 125 µm and moisture content was 5.8%. This DFMP can be stored for a long time in an air-tight condition and can later be used for different purposes. Like incorporating it into drinks or to other food products to fortify them. It can be used by the food industries for enriching their products.

Keywords: Foxtail millet, Millet milk, DFMP, production, physicochemical properties

I. INTRODUCTION

Present time have observed a lot of changes from before. With development in technology, there is increased availability processed, fast food and ready-to-eat food. Modernization and urbanization lead to a busy lifestyle for people. Which further results in high demand for easily available foods. Studies have shown that mostly people from younger generation have a tendency to order many things online to reduce the time used for going to market and buying. Mostly this happens while they are at work (52.4%), not willing to go out (51.4%), lack of time and don't know how to cook (39.8%), tempted by the advertisement (34.5%), bad weather (26.0%), obsession flavour of delivering food (18.8%), and due to habit (12.9%). Therefore, increased demand for online supply. [9] These resulted in less time availability makes them go for options like processed, junk, fast food or ready-to-eat food. As recent trend shows that cooking proper meals and having them has become only optional and occasional ritual. This trend leads to change in dietary habit. Dietary habit change shows devoid of natural food components in meals. When there is less amount or absence of these natural food sources, this impacts on nutrition level of people. They only get provided with energy, carbohydrate and fat and maybe protein to some extent but don't get all essential amino acids and vitamins, minerals and functional components of food. All these provide good health and protects against different disorders.

Studies have also shown that Covid-19 pandemic period played an important role in the diet and lifestyle pattern of people especially the lockdown period. Because that period impacted on the demand and availability of resources and people became more sedentary, thereby increased demand for easy to eat food options. But at the same time there is also an increase in health consciousness. People become more alert about their health and body [7]. Ultimately what people demands make a lot of impact on what opportunities are there. [9]

Millets are considered as 'future crop' as they have restraint from pest and diseases and also they can grow in any kind of harsh environment. Millets comes under cereals but they are five times richer than cereals. They are

called 'Superfoods'. This is because they are rich in vitamins, fibre, proteins, and minerals (calcium and iron) and are also gluten-free and therefore can be in diseases like celiac diseases. Apart from this it also has slowly digestible starch and resistant starch and which causes slow release of glucose and thereby provides the satiety. Other health benefits include preventing the colorectal cancer, increasing the diversity of gut microbiota, preventing cardiovascular disease, diabetes and obesity. [6]

In this study we are obtaining foxtail millet milk powder. foxtail millet milk consists of protein (6.85±0.13g/100 g), crude fibre (2.43±0.32g/100 g), reducing sugar (2.02±0.27g/100 g), phytic acid (15.31±0.23mg/100 g) [13]. The only drawback in millet is its antinutritional factors which can be reduced by processing methods such as soaking and germination also this can increase the bioavailability of nutrients. [11]. After extraction foxtail millet milk can get deteriorated very easily thus its important to have thermal processing. In this study we are dehydrating the foxtail millet milk thus increasing the shelf life.

Aim: To analyze the physicochemical properties of dehydrated foxtail millet milk powder

Objectives:

- Processing of foxtail millet and obtaining foxtail millet milk
- Production of dehydrated foxtail millet milk powder (DFMP)
- Analysis of functional and chemical characteristics of DFMP

REVIEW OF LITERAUTE

II.1. Millets are called future crop:

Millets are small seeded cereals belongs to poacea family [2]. This is the oldest crop cultivated even before rice and wheat. The most commonly cultivated millets include pearl millet, foxtail millet, proso, finger and kodo millet [14]. Among them foxtail, kodo, proso millet are also called as small millets, a generic term used for coarse millets. These are now grown in semi-arid and tropical regions of Africa, Asia, Australia, South America and especially in China, India, Mali, Nigeria, and Niger [2]. These millets are called the 'future crop', as they can be grown in the environment of semi-arid and tropical areas and they are free from pests and diseases. Millets are nutritious crop, rich in vitamins, minerals, resistant starch, amino acids such as tryptophan and methionine etc. It also falls under the C4 crops which have a characteristic of up-taking the carbon dioxide from environment and converting to oxygen. Also, it has high efficiency of water use, does not need much input and thus environment friendly [6]

II.2. Millets are lucrative crop:

Millets are very beneficial crop which is more nutritive value as compared to rice and wheat. It is gluten free thereby can be used by celiac disease or gluten intolerance people [10]. Apart from that, millets are also useful in preventing heart disease, diabetes, respiratory tract diseases, diabetes, bad cholesterol, gastro-intestinal diseases [6]. World has several diseases, which are mainly caused by the nutritional imbalance of the diet. Millets are rich in several macro and micronutrients and thus it provides advantageous effect on preventing these diseases [8]. Foxtail millet has several health benefits. It has a greater nutritional value compared to major cereals such as wheat, rice due to its dietary fibre, resistant starch, vitamins, minerals, and essential amino acids content, except for lysine and methionine. Among the commonly used millets such as proso, pearl, kodo, foxtail and finger millet, foxtail millets has the highest protein content. It also contains a high amount of stearic and linoleic acids, which helps in maintaining a good lipid profile. It also has the minimum amount of carbohydrate [6]. Apart from being rich in these nutrients foxtail millet also has several health benefits. That includes preventing the colorectal cancer, increasing the diversity of gut microbiota, preveting cardiovascular disease, diabetes and obesity.

II.3. Extraction of millet milk is a novel approach:

Millet though it has lot of health benefits, still contains a lot of antinutritional factors like cereals and pulses. Also, millets have high fibre content which is not good for children and elderly people and may cause digestion problem. Hereby it is important to do some processing to reduce those factors. Soaking is on of the process which increases the nutritional value of millets [11], which also reduces the fibre content. In Indian markets there are not many millets milk-based by-products. And there is not much work related to this. [13]. Thereby, it has great prospects for millet milk-based by-products and value addition of other products.

II.4. Millet milk has multidimensional aspect:

The millet milk obtained from foxtail millet have various aspects of use. It can be used as drink. It has lot of beneficial nutrients. But studies have shown that consumers likability for this is not up to the mark. Which was due to taste, flavour or it may be due the lack of awareness [3]. Researchers also made curd out of foxtail millet milk. That actually showed positive results as when they made curd out of foxtail millet milk it got least acidity, and it had quite high overall acceptability than any other millet [11]. One disadvantage is though plant-based milk has similar appearance but they gets easily spoiled if kept outside. Only thermal processing can prevent this [12]. The present study aims to dehydrate the foxtail millet milk to have better shelf life.

II.5. Millet milk powder can be used in various ways:

Dehydrated foxtail millet milk powder can be stored for a long time in an air-tight condition. This powder can be if various use. In the past roasted millet was used to make khichdi which was successful as shown by sensory score card [4]. Foxtail millet powder also got used to pinni, cookies, rusk all of them had a good sensory attribute [1]. In one research article foxtail millet milk powder was used to make pasta which was compared with Maida for its properties. As for sensory properties it got good acceptability. Pasta made from foxtail millet milk powder also had less carbohydrate, high protein and other nutrients promoting health benefits [5]. Thereby it can be said that other products like cookies, rusk, ready-to-eat food products can be incorporated with dehydrated foxtail millet milk powder to improve their nutritive quality.

II. METHODOLOGY:

III.1. Procurement of raw materials:

Millets are rich source of plant protein, vitamins, minerals, anti-oxidants. Foxtail millet has highest amount protein among thecereal group. Procurement should be done from government agricultural institution, but in the year of 2023, there is no cultivation, the old samples had been distributed to other organic and retail shops. Due to this reason foxtail millet was procured from local market of Karnataka. The millets were drawn from the Organic World, Cunningham Road, Vasanthnagar, Bengaluru, Karnataka- 560051. As organic food includes those which has been cultivated on the ground where the chemical pesticides are not used.

III.2. Processing:

After the procurement of raw material, the first step was to extraction of millet milk and obtaining dehydrated millet milk powder. For this purpose,100 g of whole foxtail millet was weighed and 300 ml of water (1:3 w/v) was added to it [13] and soaked for 8 hours. Then the soaked millet has been grinded to fine slurry with 100 ml of water. After that it was filtered through muslin cloth to obtain millet milk. Then this milk was dried overnight in hot air oven at 50 and then it was made into fine powder and weighed. It can be stored in refrigerator for the future use. The dehydrated foxtail millet milk powder (DFMP) was then analysed for its functional properties like (bulk density, water-holding capacity, oil-holding capacity, foam capacity) and chemical properties like (moisture, fat and protein content).

III.3. Functional analysis:

Bulk density is the indicator of powder compaction. For this test total 2 g of sample was taken in a 10 ml measuring flask and it was tapped until it settled to a fixed level. Volume reached has been taken and calculation was done using the formula m/v, where m is mass or total weight of sample taken and v is volume reached in the measuring flask after successful containment. pH of the sample was also determined with the use of pH meter. This is very factor as nutrient content; product quality may depend on this. For this 1 g sample was taken and to it water was added to make a solution and pH was measured. Water-holding capacity (WHC) is a measure of the total amount of water that can be absorbed per gram of a protein powder. And Oil absorption capacity (OAC) is an important functional property in food. OAC influences flavour, texture, mouthfeel, and product yield. At first two empty centrifuge tube was weighed & 1 g of sample was taken in each of the two centrifuge tubes. To that 10 ml of water was added for WHC in one tube. And 10 ml of oil was added to another tube for OAC. They were mixed properly and was left for 30 minutes. Then they were centrifuged at 3000 rpm for 25 minutes. The sediment was collected and the tubes have been weighed and applied to the formula.

$$(w2-w1)/w0 \quad (1)$$

The foaming capacity measures the amount of interfacial area created by protein during foaming. For this purpose, 2 g sample was taken in a measuring cylinder and 10 ml of water is added to it and it has been shaken vigorously. After that volume of mixture was collected till the mark with foam. This is calculated using the formula-

$$(v2-v1)/v1 \times 100 \quad (2)$$

III.4. Chemical properties:

Protein content: Protein is an essential macronutrient, which is present in different food groups in varying concentration. Protein content is analyzed using the kjeldahl method of protein estimation. This test includes three stages of estimation- digestion, distillation and titration. For digestion 2 g of sample was used with 5 g of mixed catalyst (5:1, potassium sulphate : cupric sulphate) and 10 ml concentrated sulphuric acid at 420℃ for 3 hours. Next distillation was done using 4% boric acid with 5 drops of methyl red and 2 drops of bromocresol green and 40% NaOH as an indicator. Followed by this titration using 0.1 N HCl and value found in titration is then applied to a formula to get total nitrogen content. Formula is-

$$(14\times0.1 \text{ (sample titre value-blank titre value)} \times100) /(\text{sample weight}\times1000) \quad (3)$$

Then % protein content was calculated with the formula- 6.38×%Nitrogen found from last step

Fat content: Fat is another essential micronutrient of any food product, which determines the shelf life and quality of product. Fat content is determined by using the petroleum ether extraction of fat by Soxhlet apparatus. The fat is calculated using the formula-

$$(W2-W1)/W1\times100 \quad (4)$$

Moisture analysis: this determines shelf life of any product. Moisture content was analyzed by keeping the sample in hot air oven for 2 hours at 102℃. Then by calculating it with the formula-

$$((W1) – (W2)\times 100)/(\text{Weight of the sample}) \quad (5)$$

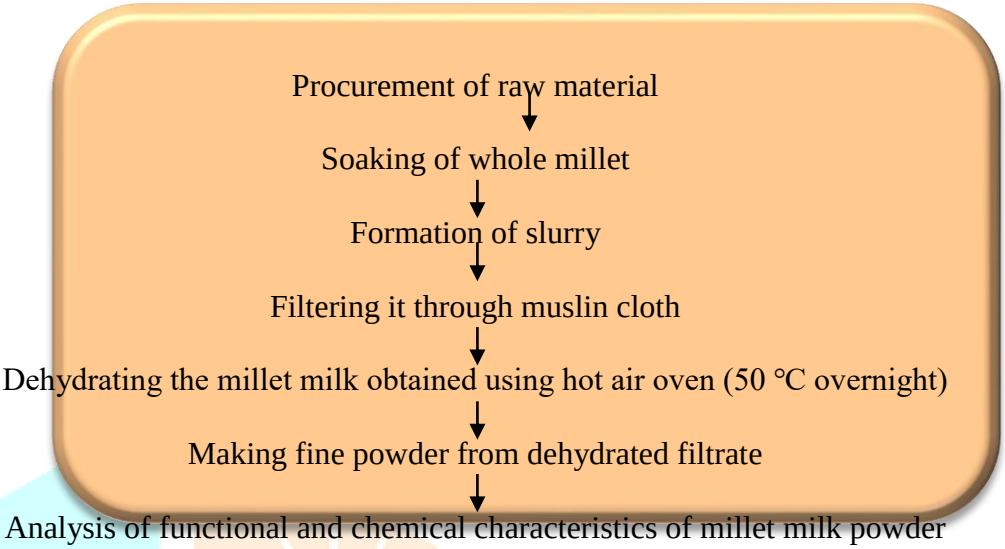

Fig1: Methodology of the study

Fig2: soaking

Fig3: foxtail millet milk

Fig4: DFMP

IV. RESULTS:

After dehydrating the millet milk total amount of dehydrated foxtail millet milk powder (DFMP) obtained was 7 g from 100g foxtail millet. The functional characteristics were analysed. Bulk density was 0.5g/m^3, pH was 6.24, foam capacity was 40%. The particle size of DFMP was 125 µm. water holding capacity and oil holding capacity was 0.81 and 1.2 ml/g respectively. The protein content from kjeldahl method was 7% and the fat content from Soxhlet was 3.6 %. Total moisture present was 5.8 %.

Table1: functional analysis:

Characteristics	Obtained result	Reference value
Bulk density (g/m^3)	0.5	0.8 (millet flour)
pH	6.24	5.93 (millet flour)
Water absorption capacity (ml/g)	0.81	166.2 ± 3.2g/ 100 g (whole millet)
Oil absorption capacity (ml/g)	1.2	91.1 ± 1.9g / 100 g (whole millet)

Table2: chemical analysis:

Characteristics	Obtained result	Reference value
Protein (%)	7	6.85±0.13 g/ 100 g (millet milk)
Fat content (%)	3.6	0.50± 0.17 g/100 g (millet milk)
Moisture content (%)	5.8	9.4 ± 0.3 g/ 100 g (millet milk)
Carbohydrate (g/100g)	55	65.5± 0.3 g/ 100 g (millet milk)

***** All the reference values are for foxtail millet flour, whole foxtail millet and foxtail millet milk.***

V. DISCUSSION:

According to the results the DFMP is rich in protein, low in fat and as it is obtained from foxtail millet milk it has less carbohydrate and fibre. Millet fibre is not beneficial for children and elderly, So, DFMP is low in fibre can be incorporated into diet of all age age-groups. As it has low moisture, it has good shelf life if stored in a proper air tight condition. This powder is alkaline in nature which imparts that it would have less chance of getting off-flavour, taste changes etc. also vitamins and minerals present in the millet will be present in DFMP.

VI. CONCLUSION:

In this study dehydrated foxtail millet milk powder (DFMP) was obtained. And functional and chemical properties of that DFMP was measured. such as bulk density, pH, water holding capacity, oil holding capacity, particle size and also protein, fat and moisture content. This DFMP can be used in future by incorporating in various food products or it be used to different products.

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