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Estimation of phytochemicals in Millets and selected Millet products

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Abstract

Millets are called super foods because of the numerous health benefits they have more nutrients phytochemicals and anti-nutrients it should be required for maintaining a good health and to assess the nutritional and phytochemical analysis of millets and selected millet products.

Millets were purchased from Tirupati, Chittoor District, and Andhra Pradesh in January month 2022. The selected millet products were developed under laboratory conditions with standard protocol it includes standardization of the products, sensory evaluation nutrient analysis and phytochemical estimations of the millets and millet products. The aqueous extract of the eight millets *i.e*. Jowar, Korralu, Ragi, Bajra, Udalu, Arikalu, Varigalu and Samalu were selected for qualitative and quantitative phytochemical analysis.

The results showed that selected millets and millet products have a good phytochemical and nutrient composition. Highest flavonoid contents were observed in foxtail millet (7.808 mg/g) and high alkaloids was present in barnyard millet (2.149mg/g) and least in finger millet (0.058mg/g).

In the present study all the selected millets and millet products showed the presence of phytochemicals flavonoids, saponins, tannins such as phenols, tannins, flavonoids, alkaloids and terpenoids are not directly involved in maintenance of body health but play major role in curing chronic diseases. The food products developed by millet products nourish the body and prevent different diseases like diabetes, CVD, cancer, inflammation, gastric and other disorders.

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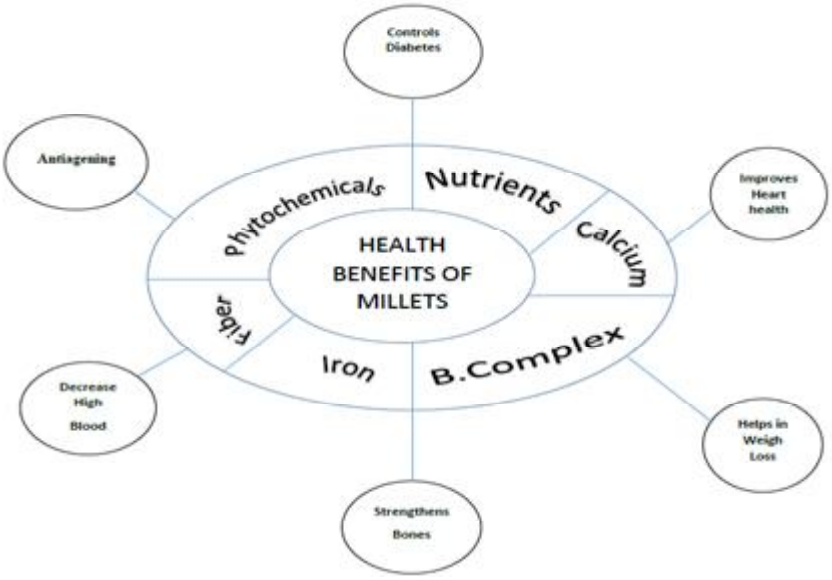

Fig. 1. Graphical representation Introduction

One of the basic human need is food, the food which we need. Following Hippocrates's "Making Food Your Medicine and Medicine Your Food", in recent years people have become more focused on functional foods[11]. Grains are widely consumed and play an important role in human nutrition. Among the grains, minor millets have recently attracted the attention of scientists and nutritionists as these contribute significantly to potential health benefits and national food security[1].

Cereals are the staple food of most people in the world. Millets are the small grass seeds, one of the oldest known ingredients in human food. They are nutritious, easy-to-digest grains and can be found all over the world. In East Asia, these plants are cultivated for emergency purposes and are widely consumed due to the vitamin deficiency, nutrients and mineral capacity of rice[13]. In addition, these plants also contain biologically active compounds, including tannins, phenols, alkaloids, flavonoids, terpenoid and saponins which are associated with antioxidant activity[27].

Millet has many health benefits such as good protein (rich in essential amino acids), carbohydrates (hypoglycemic index), fats, fibers, folic acid, and vitamins such as thiamine, niacin and riboflavin, and minerals such as iron, calcium and potassium. Ingredients include phosphorus, antioxidants and other phytochemicals[4,18,24].

Millets are also high in phytochemicals and micronutrients. Phytochemicals are naturally active plant-based organics that are involved in combating illness and maintaining good health. Examining these phytochemicals helps identify bioactive compounds involved in disease prevention because of their antioxidant and antibacterial properties. The phytochemicals

and phenolic compounds found in small millets, enhance their antioxidant properties and are nutritionally superior to other grains[21]. Millet foods are also potentially labeled as prebiotics and have the potential to increase probiotic survival as well as potential health benefits[25].

Being rich in antioxidants, millets are being used as nutraceuticals. They are reported to be helpful in treatment of migraine, asthma, blood pressure, diabetes, heart isease, atherosclerosis and heart attack[3]. Dietary supplement as medicinal food, maintain happiness, improve health, regulate immunity, and specifically treat the diseases[15]. Because of various reported health benefits of millets, these can be used in functional foods as Nutraceuticals for prevention and treatment of lifestyle diseases. Hence,they are also known as 'nutricereals'. These have important role in national food security and potential health benefits in fighting various diseases. For making them edible and to improve their nutritional and sensory properties, millet grains, are generally processed by commonly used traditional processing techniques such as decorticating, malting, fermentation, roasting, flaking, and grinding[26].

One of the study focused on treatment techniques to reduce antinutrients that reduce the digestibility and bioavailability of millet nutrients. In developing countries, due to the prevalence of malnutrition and various lifestyles such as obesity, diabetes, cardiovascular diseases, skin problems, cancer, celiac disease, due to lack of awareness, research and processing techniques. It is not fully utilized. New treatment and preparation methods are required to improve bioavailability of micronutrients & improve quality of millet-based diet. Developing millet-based dietary supplements at an economic cost to the poor is necessary to ensure their proper use and improve the nutritional status of society[15]. Therefore, keeping in mind this study was conducted to analyze the nutrient and phytochemical content of locally available sorghum and artificial sorghum products.

Source of material :

Millets were purchased from the Tirupati, Chittoor district, Andhra Pradesh, in the month of January 2022. All chemicals used for the analysis were of analytical grade.

Processing of millets flour :

Millets were cleaned and sundried at 35°C for 6 hours. The dried millets were milled in attrition mill. Milled flour was stored in air tight glass container at room temperature prior to further analysis as raw millet flour.

Development of millet products :

Ragi laddu, bajra nipatlu, kodo millet garalu, multimillet muruku, multi millet upma and multi millet noodles were developed through standarded protocols it includes standardization, sensory evaluation.

Nutrient analysis :

The nutrient analysis of the developed products was done using standard protocols. The nutrients carbohydrates (g) (Hab clin[9]), Protein (g) (Hawk's[12]), Fat(g) (AOAC[2]), Calcium (mg) (Clarket and Anal[5]), Iron (mg) (Dr.[6]), Vitamins (Oser,[19]), were analyzed.

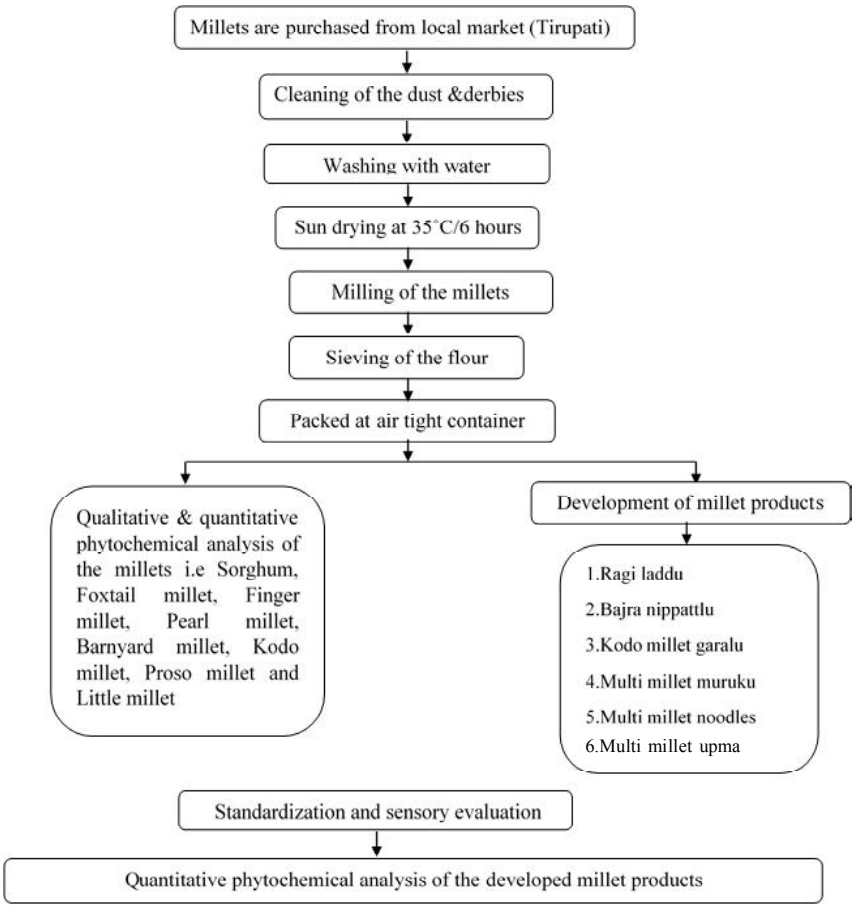

Fig. 2. Research design

Phytochyemical screening :

Qualitative analysis :

The phytochemical qualitative analysis of the millets and developed millet products was done using standard protocol flavonoids (mg/g), alkaloids(mg/g), tannins (mg/g), phenols (mg/g), terpinoids(mg/g) and saponins (mg/g) (Prabhavathi *et al.*,[20]) were analyzed.

Quantitative analysis :

Determination of quantitative phyto-chemical analysis in millets and millet products was done through the standard protocols they are Flavonoids (mg/g) (Harborne *et al.*,[10]) Alkaloids (mg/g) (Harborne *et al.*,[10]), Phenolic (mg/g) (Khaabmadi *et al.*,[14]), Tannin (mg/g) (Naima Saeed *et al.*,[23]), Saponins (mg/g) (Yasin *et al.*,[29]) and Terpenoids (mg/g) (Govindappa *et al.*,[8]).

Table-1. Qualitative phytochemical analysis of the millet flours

Name of the millet	Jowar	Korralu	Ragi	Bajra	Udalu	Arikalu	Varigalu	Samalu
Flavonoids	+	+	-	+	+	+	+	+
Alkaloids	+	+	+	+	+	+	+	+
Saponins	+	+	+	+	+	+	+	+
Tannins	+	+	+	+	+	+	+	+
Phenols	+	+	+	+	+	+	+	+
Terpinoids	+	+	+	+	+	+	+	+
Glycosides	-	-	+	-	-	-	-	-
Protein	+	+	+	+	+	+	+	+
Carbohydrates	+	+	+	+	+	+	+	+
Amino acids	+	+	+	+	+	+	+	+

(+ red color indicates the presence of phytochemicals, - green color indicates the absence of phytochemical in the particular component)

The table-1 shows the qualitative analysis of phytochemicals present in the selected millet flours. For phytochemical estimations ethanol was used as solvent to extract the phytochemicals present in different millets. Phytochemicals flavonoids, alkoloids, saponins, tannins phenols, terpinoids, proteins and carbohydrates were present. Glycosides was absent in all the millet flours except ragi flour. Lydiya *et al*.,[17] reported the qualitative analysis of extracts found the presence of phenolics, tannins, alkaloids, saponins, carbohydrates, protein, glycosides, fibers and flavonoids. These results are similar with the present study findings.

Phytochemals are biologically lively natural substances of plant origin. These components are involved in stopping illnesses and fitness promotion. Screening of the phytochemicals can also additionally assist in locating the lively compounds liable for illnesses prevention and treatment. Most of the phytochemicals have antioxidant property[22]. Florence Suma and Urooj[28] observed that phytochemicals of these millets prevent colon gastric prostate and most of the breast cancers.

In the present study the phytochemical glycosides were observed in the absence of all millets except in finger millet. However a study also reported that glycosides were not observed in millets like barnyard millet, little millet, pearl millet, sorghum and Italian millet[27].

The table-2 shows the yield and preliminary phytochemical screening of the ethanol extract of millet seeds obtained by simple filtration method showed the variation in color appearance ranges from light yellow color were observed in the sorghum, foxtail, finger, barnyard millet and proso millet to dark yellow colour observed in the pearl millet and kodo millet, and finally medium yellow color observed in the little millet. The percentage

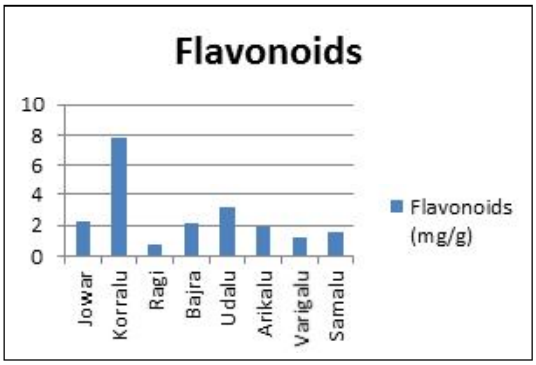

Fig 3 (a)

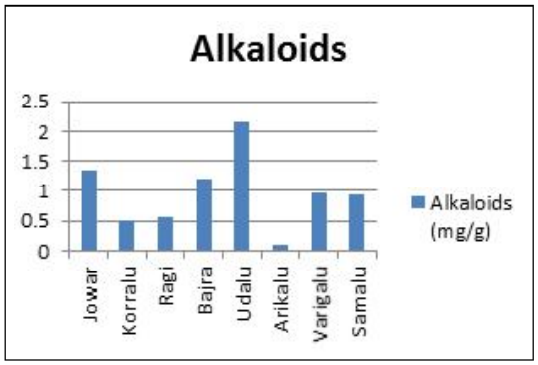

Fig 3 (b)

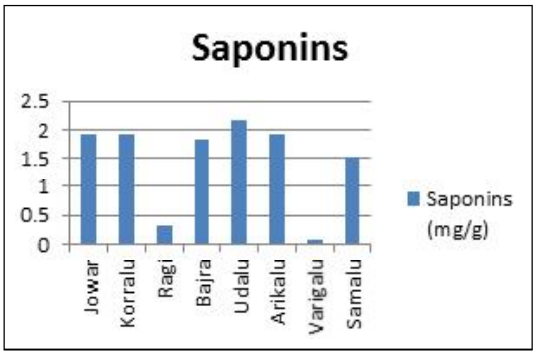

Fig 3 (c)

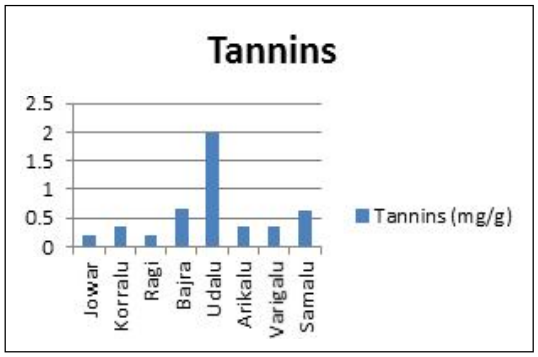

Fig 3 (d)

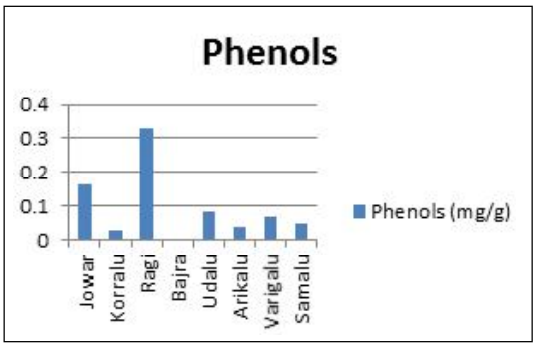

Fig 3 (e)

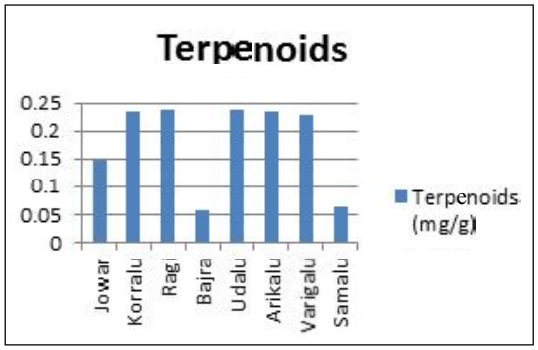

Fig 3 (f)

Fig. 3. Quantitative analysis of phytochemicals in the selected millet flours

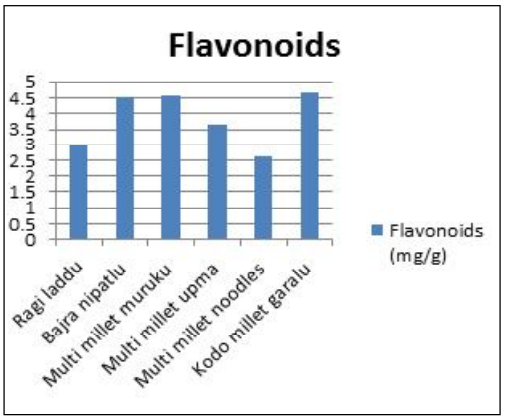

Fig 4 (a)

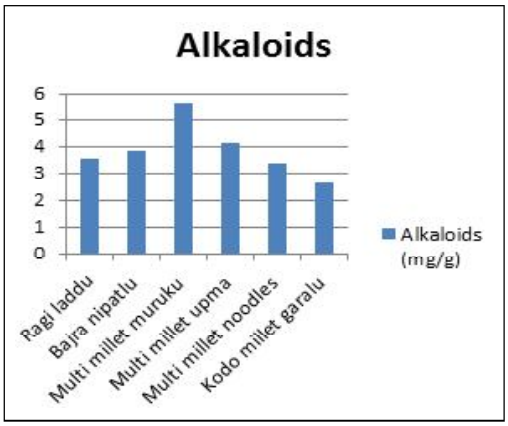

Fig 4 (b)

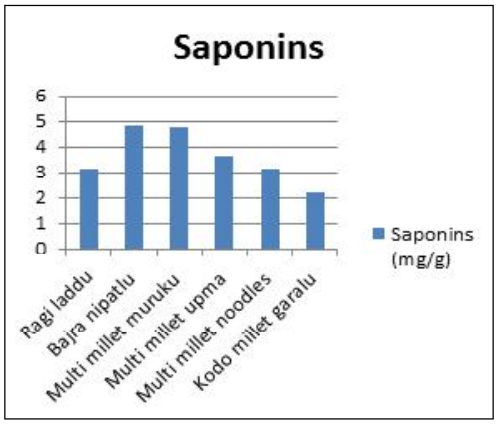

Fig 4 (c)

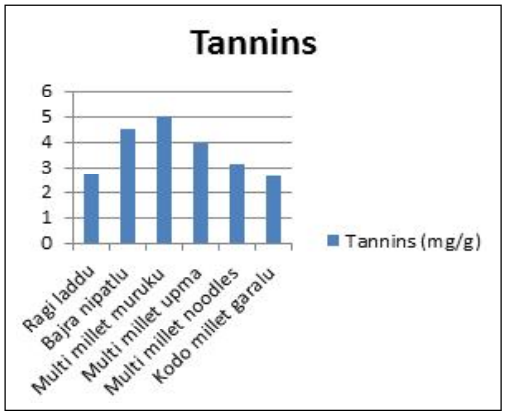

Fig 4 (d)

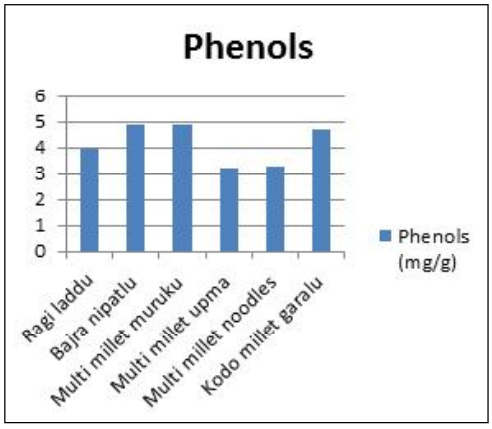

Fig 4 (e)

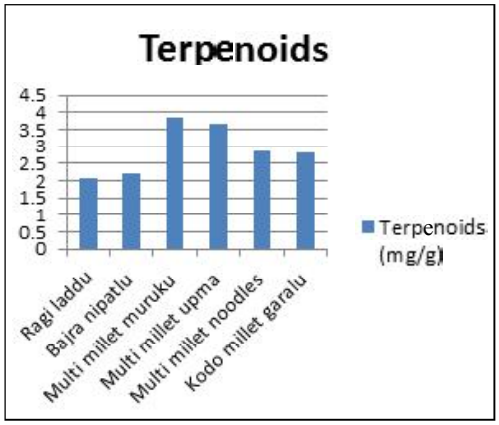

Fig 4 (f)

Fig. 3. Quantitative analysis of the millet products

Table-2. Appearance of millet flours from ethanol solvent of different millets fours

Sample	Appearance of extract	Quality of millets material	Weight of extract	Percentage yield
Sorghum (jowar)	Light yellow	100	0.64	66
Foxtail millet (korralu)	Light yellow	100	0.26	19
Finger millet (ragi)	Light purple	100	0.58	21
Pearl millet (bajra)	Dark yellow	100	0.57	52
Barnyard millet (udalu)	Light yellow	100	0.21	19
Kodo millet (arikalu)	Dark brown	100	0.38	27
Proso millet (varigalu)	Light yellow	100	0.42	29
Little millet (samalu)	Medium yellow	100	0.62	28

yield of crude extract ranged from 19- 66%, the highest yield was 66% in sorghum millet and lowest yield 19% of the barnyard and foxtail millet respectively.

The quantitative analysis of extracts for determination of flavonoids, alkoloids, saponins, tannins, phenols and terpinoids content revels that korralu (7.808mg/g) shows highest flavonoids content followed by udalu (3.0mg/g), jowar (2.1 mg/g), bajra and arikalu (2.0mg/g) samalu (1.9mg/g), varigalu (1.5mg/g) and lowest content of flavonoids was observed in the *i.e* (0.5mg/g) respectively.The alkaloids content was examined as high in udalu (2.149 mg/g) and least content in arikalu (0.107mg/g). The total saponins analysis revealed that, udalu millet has maximum saponins content (2.157mg/g) compared to other samples. The results are depicted in the fig. 2. In phytochemical analysis tannin was observed high in udalu and followed by millets like jowar korralu, ragi, arikalu, varigalu and samalu was present in low content of tannins. The phenols content was found to be maximum in ragi (0.321mg/g) sorghum (0.208mg/g) very minimum content of phenols were present in bajra (0.132). Among the selected millets the terpinoids content was almost all millets present in high when compared to other phytochemicals.

The phytochemical analysis of the selected millet recipe products has been presented in the figure 3 the phytochemicals flavonoids, alkaloids, saponnins, tannins, phenols and terpenoids were assessed through the ethanol solvent extraction method. It was found that flavonoids were very high in kodo millet garalu (4.682mg/g) and multi millet muruku (4.582mg/g). Alkaloids were present in multi millet muruku (5.623mg/g), multi millet upma (4.125mg/g) bajra nipatlu (3.852mg/g) was found to be containing high levels observed respectively. Highest saponins was observed in the bajra nipatlu (4.798mg/g) and low content was observed in the kodo millet garalu (2.195mg/g) The phytochemical phenol was found in almost all the millet recipes. Multi millet muruku (3.587mg/g), multi millet upma (3.658mg/g) and multi millet noodles (2.856mg/g) was observed in the high content of terpenoids and followed by the remaining *i.e,* kodo millet garalu (2.832mg/g), bajra nipatlu (2.225) and laddu (2.056mg/g).

Table-3. Proximate nutrients analysis of the minor millets

Name of the millet	Energy (k.cal)	CHO(g)	Protein (g)	Fat (g)	Fiber (g)
Sorghum (jowar)	346	73.1	10.3	1.8	1.6
Foxtail millet (korralu)	332	60.8	12.5	4.3	8.2
Finger millet (ragi)	328	71.8	7.4	1.3	3.7
Pearl millet (bajra)	361	67.4	11.4	4.0	1.3
Barnyard millet (udalu)	304	64.8	6.2	2.2	9.7
Kodo millet (arikalu)	305	65.3	8.2	1.4	9.0
Proso millet (varigalu)	341	70.1	12.2	1.1	2.2
Little millet (samalu)	342	67.0	7.7	4.7	3.4

Table-4. Proximate nutrients analysis of the minerals in minor millets

Name of the millet	Fe (mg)	Ca (mg)	Phos-phorus (mg)	Potassi-um (mg) (mg)	B1 (mg)	B2 (mg)	B3 (mg)	β carotene
Sorghum (jowar)	5.4	25	222	241	0.38	0.15	4.3	47
Foxtail millet (korralu)	2.8	31	290	232	0.41	0.11	3.2	32
Finger millet (ragi)	3.9	344	283	246	0.58	0.18	1.1	42
Pearl millet (bajra)	16.9	38	296	272	0.36	0.21	2.5	132
Barnyard millet (udalu)	15.3	11	280	296	0.33	0.1	4.2	0
Kodo millet (arikalu)	0.5	27	188	210	0.16	0.09	2.0	0
Proso millet (varigalu)	0.8	14	206	212	0.42	0.25	4.5	0
Little millet (samalu)	9.3	17	220	216	0.3	0.08	3.2	0

The results of nutritional analysis of selected millets flours were presented in table 3. The maximum energy content was observed in pearl millet (361 K.cal), followed by sorghum millet (346K.cal), little millet (342K.cal), proso millet (341 K.cal), foxtail millet (332K.cal), finger millet (328K.cal), kodo millet (305 K.cal) and Barnyard millet (304 K.cal). The maximum carbohydrate content was found in sorghum millet (73.1g), finger millet (71.8g), proso miillet (70.1g), pearl millet (67.4g), little millet (67.0g), kodo millet (65.3g), barnyard millet (64.8g) and foxtail millet (60.8g) respectively. Protein is the important nutrient it is necessary for growth and development. In comparison to other millets barnyard millet had highest fiber content (9.7g)and least in pearl millet (1.3g) Among the millets the protein content was recorded to be high in foxtail millet (12.5g) followed by proso millet (12.2g) and pearl millet (11.4g) sorghum millet (10.3g). Fat content was higher in (4.7g) and lowest in (1.1g) the low levels of fat facilitates the prolonged storage of the grains as it reduces

the food spoilage by peroxidation of polyunsaturated fatty acids. Lowest calcium is present in barnyard millet (11mg) and the highest calcium was in finger millet (344mg). The phosphorous content in kodo millet was lower than the other selected millets. Iron and potassium content was found to be high in pearl millet (16.9Mg and 272mg) and barnyard millet (15.3mg and 296mg). Very little amount of β carotene content are observed in pearl millet (132mg) followed by sorghum (47mg), finger millet (42mg) and foxtail millet (32mg). β carotene was not recorded in the barnyard millet, kodo millet, proso millet and little millet.

Millet can serve as a staple food for almost one-third of the world's population. They occupy an important position in the world's diet and economy. Screening for these phytochemicals helps identify active compounds involved in disease prevention of most phytochemicals such as flavonoids, alkaloids, saponins, tannins, phenols and terpinoids. Millets can be grown under a variety of environmental conditions. With all these points in mind, subsequent analysis of seed extracts was planned with an evaluation of qualitative and quantitative analysis of phytochemical properties. The results showed that Millet is very good for health to prevent diseases including diabetes, heart disease and high blood pressure, obesity, cardiovascular disease, cholesterol anemia and reduced risk of malnutrition. All millets contain all phytochemicals. Therefore, millet is good for health.

This gave the idea of its chemical composition containing a significant amount of fiber and carbohydrates, proteins and minerals. The results obtained from the study clearly show that different types of phytochemicals are present in different millets. The large amount of nutrients in this millet can help in the production of a variety of dietary supplements.

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