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# A Comparison of Physico-Chemical Properties, Functional Properties and Antioxidant Profile of Millets Flour

Verma Shilpa[1], Sood Sangita[2]
[1, 2]Department of Food Science Nutrition &Technology, CSKHPKV, Palampur 176062 (India)

***Abstract:*** ***The objective of this work was to investigate the physic-chemical composition, functional properties and antioxidant profile of selected (pearl millet, finger millet and sorghum) flour. Whole millets are a source of several functional ingredients and their consumption is essential for a healthy lifestyle. Some millets still remain underutilized despite their rich nutritional profile. Pearl millet had higher protein (12.11g/100g) than finger millet and sorghum. Pearl millet had highest fat (4.96g/100g) and ash contents(3.52g/100g) and crude fiber(3.63g/100g) was reported highest in finger millet flour than other millets. In terms of minerals composition, calcium and iron was high (269.54mg/100g) and (5.00mg/100g) in finger millet than other millets and phosphorous is high (218.09mg/100g) in pearl millet. Study revealed that pearl millet had highest total phenolic contents (TPC) 1.14mg/g and also good antioxidant profile among the crops studied. This signified their superior nutritional quality and suitability for functional food use.***
***Keywords: Millets, grains, physico-chemical, total phenolic contents (TPC), antioxidant profile***

## I. INTRODUCTION

Cereals and millets are most commonly consumed food items in India. However, in past few years, refined grain products have gained greater popularity. More recently, interest in whole grains has grown due to the health benefits that these are associated with whole grain consumption prevents several diseases such as cancers, diabetes and cardiovascular diseases Millets are a group of small - seeded species of cereal crops belonging to the family Gramineae and grown widely around the world for food and fodder [5]. The most important characteristics of millets is, they tolerate and survive under drought conditions Due to this characteristic of millets we can say they also play an important role in food security in this era where climate changes, water scarcity, increasing world population, rising food prices continuously.

They contain a wide range of phenolics which are good sources of natural antioxidants. Dietary antioxidants reduce free radical activity in the body and reduce disease occurrence. Finger millet (Eleusine coracana) also known, as 'ragi' is popular millet in India, consumed without de-hulling.

The tiny millet grain has a dark brown seed coat, richer in polyphenols compared to other continental cereals such as barley, rice, maize and wheat. In recent years, finger millet has gained importance, because of its nutritional strength in terms of dietary and functional fiber, starch pattern, as well as high calcium and iron contents. India is the major producer of finger millet contributing nearly 60% of global production [12].

Sorghum is the fifth most-produced cereal in the world after corn, rice, wheat and barley. USA, Mexico, Nigeria, Sudan and India are the major producers, and contributing 16%, 12.2%, 9.8%, 9.1% and 7.8% of total world production, respectively. Pearl millet (Pennisetum glaucum) is the sixth most important cereal. Pearl millet grains are mostly used for food purposes in India and Africa, it is a source of staple food for rural population.

Pearl millet is a rich source of proteins, minerals and fibre [13] . The amino acid profile of pearl millet is better than that of sorghum and maize and is comparable to that of wheat, barley, and rice [5]. There is a growing interest in these crops because of the technological possibilities of its utilization in industrial applications.

Therefore, consequent on the large scale production and commercial exploitation of the crop is the need to study the physical and mechanical attributes of these crops, which are important in the design of equipment for handling, cleaning, storing and processing. The present study is therefore aimed to study the Physicochemical, functional and antioxidant properties of selected graim flours.

## II. MATERIAL AND METHODS

Pearl millet (Pennisetum glaucum), Finger millet (Eleusine coracana) and Sorghum (Sorghum bicolor) grains were purchased from local market at palampur and from the university farm (CSKHPKV, India). All the grains were cleaned from soil particles and debris. The grains were ground directly using electrical grinder and passed through 52 mesh sieve to obtain fine flour. All the reagents used in the study were of analytical grade.

### *A. Physico-Chemical Properties*

Bulk density of flours was measured by method of Wang and Kinsella (1976) [20] . True density was determined by liquid displacement method ASAE (2001) [3]. Porosity of flour mixture was measured by method of Thompson and Issac (1967) [16]. Proximate analysis was done by method of AOAC (2010) [2] and minerals were analyzed with atomic absorption spectrophotometer Model 3100, perkin Elmer, and flame photometer, Mediflame127.

### *B. Functional Properties*

Water absorption index (WAI) and water solubility index (WSI) were determined by the method of Anderson (1982) [1]. Foaming Capacity (FC) and Foam Stability (FS) were determined by method of Narayana and Narasinga Rao (1982) [7]. Oil absorption capacity was determined with slight modification to the method of Wani et al., (2013) [21].

### *C. Antioxidant Profile*

Antioxidant profile was as total phenolic content, total flavonoid content and ferric reducing antioxidant power was measured by method Chandra and Dave (2009) [4].The data reported in all of the tables are the averages of triplicate observations. Statistical analysis of the results was done with Microsoft Excel 2007 (Microsoft Office) determine the means.

## III.RESULT AND DISCUSSION

### *A. Physical Properties*

The raw materials pearl millet, finger millet and sorghum flour were analyzed for physical properties and the data shown in Table I. The color of the crops were observed manually and found gray, redish Brown and red for Pear millet, Finger millet and Sorghum respectively. Shapes of the selected crops were also observed manually and reported as oval (Pearl millet), round (Finger millet) and oval (Sorghum). The bulk density of pearl millet finger millet and sorghum flours ranged from 0.87g/ml to 0.72g/ml. Ojediran et al. (2010) as thousand kernel weight, density, bulk density and porosity and repoterd the results as 7.3 – 9.47g, 0.96 – 0.99g/ml, 0-.81 – 0.82 g/ml and 15.17 to 17.28 g/100g respectively. Vannalli et al. [19] reported thousand kernel weight of ten different varieties of Sorghum between the range of 25.59 to 41.01g. Nazni and Bhuvaneswari [8] reported the values of thousand kernel weight, bulk density of Finger millet as 2.46±0.005g and 0.70±0.01g/ml respectively.The differences in the values of bulk density between these flours are likely due to varietal differences. Bulk density is a measure of heaviness of flour and is generally affected by the particle size and the density of the flour. It is very important in determining the packaging requirement, material handling and application in wet processing in the food industry.

TABLE I

Physical parameters of selected test crops

| Crops | Pearl Millet | Finger millet | Sorghum |
|---|---|---|---|
| Colour | Gray | Redish Brown | Red |
| Shape | oval | Round | oval |
| 1000 K Wt (g) | 9.05 | 2.31 | 31.73 |
| Density (g/ml) | 1.45 | 1.36 | 1.25 |
| B.Density (g/ml) | 0.72 | 0.72 | 0.87 |
| Porosity (g/100g) | 20.12 | 46.94 | 30.20 |

### *B. Chemical Composition*

Table II represents the chemical composition of millet flours. Moisture content of pearl millet, finger millet and sorghum flour were 9.53, 8.47 and 7.25 per cent respectively. Ash content of pearl millet, finger millet and sorghum flour are 2.48, 2,41 and 1.43 percent respectively. Pearl millet had highest fat content of 4.93 per cent as compared to finger millet and sorghum as 2.00 and 2.67 per cent respectively. Protein content of pearl millet was 12.03 per cent, finger millet 7.45 per cent and sorghum 2.67 per cent. Carbohydrate content of pearl millet was 68.33, finger millet 76.04 and sorghum 75.07 per cent respectively. Vanisha et al. [18] studied the Pearl millet and Sorghum and found carbohydrate content in Pearl millet 67.5, 67, 57, 69 per cent from four different sources and carbohydrate content in Sorghum was 72.6 per cent which is very close to the test crop. Thilagavathi et al. [15] reported protein content in Pearl millet and horse grams as 11.84 ± 0.30, 21.25 ± 0.67 per cent respectively which are in accordance with the present study.In minerals composition, calcium and iron was high (269.54mg/100g) and (5.00mg/100g) in finger millet than other millets and phosphorous is high (218.09mg/100g) in pearl millet. Potassium and sodium was found highest (302.06) and (7.17mg/100g) in sorghum flour, while zinc content was found highest in pearl millet flour.

Table III
Chemical Composition of Selected Test Crops (G/100G)

| Crops | Pearl Millet | Finger Millet | Sorghum |
|---|---|---|---|
| Moisture (g/100g) | 9.53 | 8.47 | 7.25 |
| Ash (g/100g) | 2.48 | 2.41 | 1.43 |
| Crude Fat (g/100g) | 4.93 | 2.00 | 2.67 |
| Crude Fiber (g/100g) | 2.7 | 3.63 | 2.35 |
| Crude Protein (g/100g) | 12.03 | 7.45 | 11.23 |
| Carbohydrates (g/100g) | 68.33 | 76.04 | 75.07 |
| Calcium (mg/100g) | 27.82 | 269.54 | 22.56 |
| Magnesium (mg/100g) | 124.23 | 343 | 112.09 |
| Phosphorus (mg/100g) | 218.09 | 8.21 | 208.35 |
| Potassium (mg/100g) | 39.01 | 5.10 | 302.06 |
| Iron (mg/100g) | 12.08 | 5.0 | 3.84 |
| Zinc (mg/100g) | 3.03 | 2.81 | 1.32 |
| Sodium (mg/100g) | 7.08 | 0.95 | 7.17 |

### *C. Functional Properties*

The raw materials pearl millet finger millet and sorghum flour, were analyzed for functional properties and data shown in Table III. Water absorption capacity (WAC) was observed highest in pearl millet as 72.01g/100g.Related to oil absorption capacity (OAC) of studied different millet flours, OAC of pearl millet flour was also found to be 184.21g/100g, fingerl millet flour is 78.23 and that of sorghum 76.23g/100g respectively.

Table IIIII
Functional properties evaluation of Selected Test Crops

| Crops | Pearl Millet | Finger Millet | Sorghum |
|---|---|---|---|
| WAC (g/100g) | 72.01 | 64.21 | 61.03 |
| OAC (g/100g) | 84.21 | 78.23 | 76.23 |
| FC (g/100g) | 2.70 | 6.30 | 3.60 |
| FS (g/100g) | 1.80 | 5.10 | 2.50 |
| WSI (g/g) | 9.13 | 6.12 | 2.83 |
| WAI (g/100g) | 8.25 | 1.23 | 0.74 |

There is an advantage for best organoleptic characteristics of meal that high water and oil absorption capacity of the flour can positively influence the flavor, moisture and fat content in food. The foaming capacity (FC) of a flour refers to the amount of interfacial area that can be created by the protein and foam stability (FS) refers to the ability of protein to stabilize against gravitational and mechanical stresses. Foaming capacity of pearl millet, finger millet and sorghum flour was found to be 2.70, 6.30 and 3.60 per cent respectively. All grain flour pearl millet, finger millet and sorghum also having low foaming stability. In fact, the foam formed by the flour has no stability over time. This could be due to the protein denaturation caused by grinding. It has been reported that the native proteins provide high foam stability than denatured proteins . Moreover, the low or absence of foaming capacity of certain meals could affect their stability during storage. Water solubility index (WSI) was observed highest in pearl millet 9.13g/g followed by finger millet and sorghum 6.12 and 2.83 g/g respectively. In case of water absorption index (WAI) ranged from 0.74 (sorghum) to 8.25 (pearl millet) per cent respectively Thilagavathi et al. [15]. Olosunde et al. [10] reported the functional properties of Sorghum as water absorption capacity 2.49± 0.11, water solubility 2.56±0.23 per cent and oil absorption 0.79±0.17mg oil /g. Gull et al. [6] reported the functional properties of Finger millet as water solubility index (7.73±1.80), foaming capacity (1.96±0.00) and foaming stability (0.97±0.01)ml.

*D. Antioxidant Profile of Selected Crops*

The data for antioxidant profile of raw materials pearl millet, finger millet and sorghum flour presented in Fig.1. The total phenolic content 1.13 (mg/100g GAE) and Frap content (1.15 mg/ml) of pearl millet was higher whereas finger millet have the highest total flavonoid content 0.45 (mg/100g Quercitien) The concentration of antioxidants present in the grains may vary depending on the species, cultivar, and growing location and environmental conditions, among others. Also dehulling decreased the TPC of whole grain millets and this change was essentially due to the removal of the outer layers of the grain, as phenolic compounds of cereal grains are mainly concentrated in the outer layers of the grain .

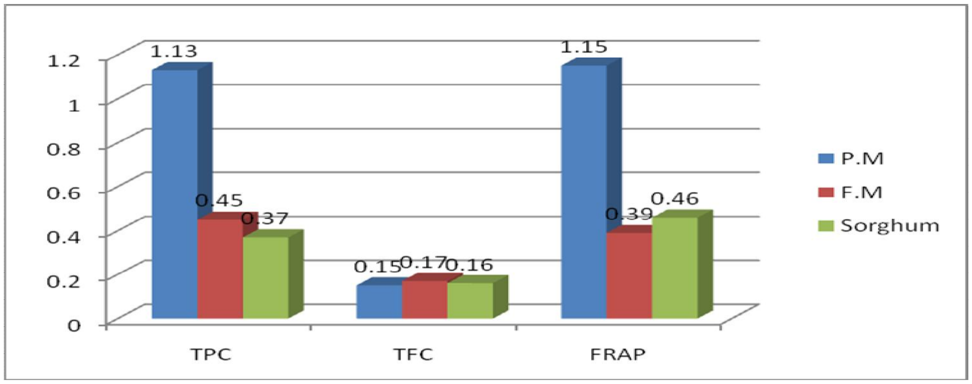


Fig.1. Antioxidant profile of selected crops

## IV. CONCLUSIONS

The results of the study revealed that all millets flour has a great potential for nutrition and health, antioxidants present in the millets can reduce free radical activity in the body and reduce disease occurrence. These millets have the potential to be used in food industry for the purpose of formulating new products. They can also be used for the replacement of conventional flour sources in food products. There are also vast scopes in the field of functional food from such grains.

## V. ACKNOWLEDGMENT

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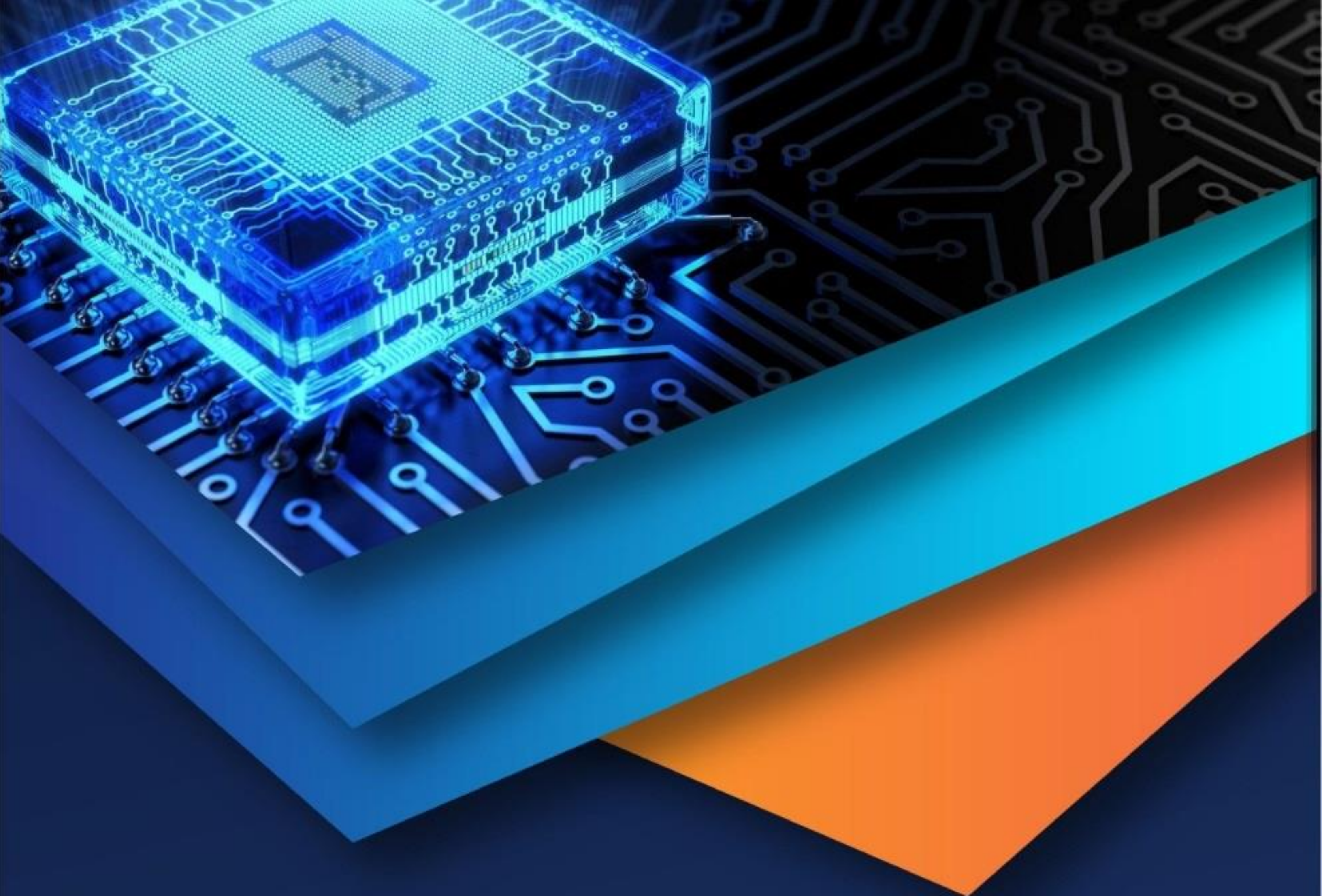


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