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# Impact of Selected Processing Techniques on Proximate and Mineral Profiles of Millets: A Comparative Study with Wheat Flour

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## ABSTRACT

Finger millet (*Eleusine coracana*), pearl millet (*Pennisetum glaucum)* and sorghum (*Sorghum bicolor*) are climate-resilient cereals. These crops are cultivated in arid and semi-arid sections, and contribute significantly to nutritional security and food. Millets are rich sources of calcium, dietary fibre, protein and numerous bioactive elements. The present study explored the impact of different treatments, including germination, roasting and blanching on the nutritional composition of millets and to evaluate their potential as nutrient rich substitute to wheat flour. Processing treatments significantly influenced the mineral and proximate nutrient profile of millets. Germination proved to be the most effective processing treatment, leading to a significant improvement in the nutritional composition of finger millet. The germinated finger millet exhibited protein, dietary fiber, calcium, iron and zinc contents ranging from 7.77-10.13 g/100 g, 3.08-3.84 g/100 g, 333-355 mg/100g, 3.90-6.03 mg/100 g and 2.34-4.00 mg/100 g, respectively. In comparison, wheat flour showed higher protein content (11.00-12.47 g/100 g) but considerably lower dietary fiber (2.47-2.97 g/100 g), calcium (38.03-46.00 mg/100 g), and iron (2.00-3.07 mg/100 g) and zinc (3.00-4.50 mg/100 g).

**Key words:** Finger millet, mineral, processing, proximate, pearl millet

## INTRODUCTION

Food is a basic need as well as contributes significantly to the health of people. Healthy people are the backbone of any country. Food has direct impact on the growth and development of every country. India's most recent National Family Health Survey reveals that progress has stalled across key indicators of child nutritional status, including underweight, wasting, stunting and iron-deficiency anaemia (NHFS-5, 2020). Food and nutrition are interrelated and to attain this it is required that reconnoitre underutilized and traditional crops as food source which is healthy diet to feed. High dietary quality is essential for promoting optimal human health and fitness and for addressing the persistent problem of malnutrition. Malnutrition is the serious problem in various countries. Moreover, inadequate intake of iron, zinc and calcium, remains a major concern for public health. Millets offer a promising solution to this problem due to their wide availability, adaptability to diverse agro climatic conditions and superior nutritional profile. Millets comprise seven major types that vary in colour, shape, size and cultivation regions. These are small-seeded, round-shaped cereals belonging to the family Poaceae (FAO, 2020). Millets are valuable sources of both micro and macronutrients, amino acids and phytochemicals. Millets possess calcium, potassium, zinc, protein, starch, energy, magnesium, iron and sulphur containing amino acids (Sharma *et al*., 2025). In addition, millets are abundant in linoleic acid, B-complex vitamins, tocopherols, dietary fiber and phytochemicals. Millets have carbohydrates (65%), proteins (9%), fat (3%), crude fiber (2-7%), vitamins and minerals (Rondla *et al*., 2022).

Sorghum, which is available in various varieties such as white, yellow and red, is rich in bioactive compounds that confer multiple health benefits, including immune modulation, antioxidant properties and anti-inflammatory effects (Mohammed *et al.,* 2019). Finger millet was compared favourably with rye, oats and barley to provide adequate nutritional support for growing children, pregnant women and the elderly (Satish *et al*., 2017). Despite their numerous health benefits, millets contain certain anti-nutritional factors that interfere with the digestion, utilization and bioavailability of minerals, carbohydrates and proteins. These include tannins, phytates (phytic acid), saponins, protease (trypsin) inhibitors, oxalates (oxalic acid), haemagglutinins, gossypol and glucosinolates (Shyam and Singh, 2018). Anti nutritional compounds in millets including tannins, protease inhibitors, phytic acid and trypsin inhibitors affect the human health and various processing strategies such as germination, cooking, fermentation and industrial approaches like enzymatic processing, milling and extrusion are used to lower these anti nutritional components. These assist in contributing health benefits like blood pressure regulation, reduction in cardiovascular diseases, blood sugar level and thyroid (Bakshi *et al*., 2025). Germination technique enhances the bioavailability of minerals and improves the nutritional value of the millets. Despite their rich nutritional profile, particularly their high dietary fiber content, the use of millets in the development of functional foods is still largely untapped. Standardization of millet-based commercial products is, therefore, essential to fully harness their potential within the global food industry (Dey *et al.,* 2022). The growing demand for gluten free, plant based and functional foods, millets represent a sustainable dietary option. Understanding the impact of different processing techniques on their functional and nutritional characteristics is essential for value-added food products that meet the needs of health-conscious consumers and are suitable for commercial-scale production. Accordingly, the present investigation was carried out to systematically compare these processing treatments with wheat flour and to determine the extent to which they alter the nutritional characteristics of millets.

## MATERIALS AND METHODS

The mineral analysis was done in the Agriculture Department and proximate analysis Hotel Management and Food Science and Technology Department of MMDU, Mullana, Ambala, Haryana. Pearl millet, sorghum, finger millet and wheat were obtained from local retail market, Mullana, Ambala. The samples were cleared and sorted to eliminate stones, dust, as well as broken and immature grains.

Samples were washed and then soaked in water overnight. The grains were isolated by means of sieve and then placed in muslin cloths. These were then kept for germination in muslin cloth for 48 h at ambient temperature (24.2±2.7°C). The sprouted grains were completed dried for analysis. The flour was stored at ambient temperature sealed in an air-tight plastic pouch. This natural method enhanced the nutritional value. Germinated millets were softer, easier to cook, and were used in health foods and traditional preparations.

Roasting includes dry heating of grains at moderate to high temperatures. It was used to enhance the texture, flavor and shelf life of millets. Roasting of millets was done at 180-190°C for 5-10 min using an iron pan. Temperature was observed by Thermo Pro digital thermometer. This technique reduced anti-nutritional factors, enhancing digestibility, taste and pleasant aroma. Roasted millets were frequently used in flours, traditional recipes and ready-to-eat snacks.

Blanching started by heating of distilled water at 98°C in an aluminium vessel: millet grains were blanched for 30 seconds via addition of grains to the boiling water at a ratio of 1 part seeds and 5 parts water and the grains were dried at 50°C for 90 min. It helped in conserving texture, colour and nutritional quality. This technique softened the grains which made easier to cook and inactivate enzymes leading to reduced microbial load, spoilage.

Approximately 5/ g of each sample was weighed into crucibles in duplicate. The samples were then incinerated in a muffle furnace at 550°C until a light grey ash formed and a constant weight was achieved. After cooling in desiccators to prevent moisture absorption, the samples were weighed to determine the ash content.

$$\text{Ash \%} = (W_1\text{"}W_2) \times 100 / S_w$$

Where, $W_1$ represented the weight of the crucible with ash after ashing, $W_2$ was the weight of the empty crucible and SW denoted the weight of the sample taken.

Moisture content was measured using the hot air oven method at 105±1°C for 4 h.

$$\text{Moisture \%} = (W_1\text{"}W_2) \times 100 / S_w$$

Where, $W_1$ was the weight of the petri dish with the fresh sample, $W_2$ was the weight of the petri dish with the dried sample and SW represented the weight of the sample.

Protein content was determined by the Kjeldahl method and expressed as N × 6.25

Crude protien % = (a x b x 14 x 6.25) x 100/W

Where, a was the normality of the acid, b was the volume of standard acid used (ml) corrected for the blank, W was the weight of the sample (g) and 6.25 was the conversion factor used to calculate protein from % nitrogen.

Crude fiber content of the defatted sample was determined using the acid–base extraction method.

Crude fiber % = ($W_1$ “ $W_2$) x 100/$S_w$

Where, $W_1$ was the weight of the porcelain crucible with the sample before ashing, W, was the weight of the crucible containing the ash and SW representd the weight of the sample.

Fat content was assessed by fat-Soxhlet ether extraction method.

Crude fat % = ($W_1$ “ $W_2$) x 100/$S_w$

Where, $W_1$ was the weight of the empty beaker, $W_2$ was the weight of the receiver beaker with the fat extract and SW represented the weight of the sample used.

The mineral content (calcium, zinc and iron) of the millet flour samples was determined following the standard procedures.

The differences among the mean values of all treatments were analyzed using MANOVA in SPSS version 26.0 (SPSS Inc., Illinois, USA). The data were taken in triplicate, and the outcomes were presented as mean±standard deviation (SD).

## RESULTS AND DISCUSSION

The consequences of applied techniques including germination, roasting and blanching on the proximate and mineral composition of pearl millet, finger millet, sorghum and wheat reported clear variation with both millet type and processing treatments (Table 1).

In pearl millet, moisture content decreased 6.77±0.03% and 8.70±0.10 after roasting and germination, respectively, in comparison to the untreated sample (10.57±0.23%) while ash content ranged from 1.86±0.04 to 2.10±0.05%. Mane *et al.* (2023) had described comparable findings. Fat content increased upon roasting (5.58±0.02%). Protein level (12.77±0.23%) was highest in germinated pearl millet. Fiber content showed only marginal variation (2.05±0.05–2.29±0.03%), while calcium and iron contents ranged from 35.00±0.98 to 42.00±0.06 mg/100 g and 8.00±0.81 to

**Table 1.** The effect of processing treatments on the proximate composition of millets and wheat

| | Ash content (g/100 g) | Moisture (g/100 g) | Protein (g/100 g) | Fat (g/100 g) | Fiber (g/100 g) | Calcium (mg/g) | Zinc (mg/g) | Iron (mg/g) |
|---|---|---|---|---|---|---|---|---|
| UPM | 1.99±0.01 | 10.57±0.23 | 10.93±0.16 | 4.98±0.01 | 2.18±0.03 | 36.00±1.20 | 2.80±0.82 | 9.03±0.02 |
| GPM | 1.86±0.04 | 8.70±0.10 | 12.77±0.23 | 3.89±0.08 | 2.29±0.03 | 42.00±0.06 | 3.10±0.81 | 10.00±0.01 |
| BPM | 2.10±0.05 | 9.90±0.10 | 9.60±0.20 | 4.77±0.03 | 2.23±0.02 | 35.00±0.98 | 2.63±0.85 | 8.00±0.81 |
| RPM | 2.09±0.01 | 6.77±0.03 | 10.90±0.10 | 5.58±0.02 | 2.05±0.05 | 39.67±0.25 | 3.00±0.57 | 10.17±0.22 |
| UFM | 2.04±0.01 | 10.10±0.10 | 7.77±0.23 | 1.86±0.04 | 3.08±0.11 | 333.33±1.30 | 2.34±0.84 | 3.90±0.26 |
| GFM | 2.27±0.03 | 8.39±0.01 | 10.13±0.26 | 1.45±0.01 | 3.84±0.16 | 355.67±0.07 | 4.00±0.80 | 6.07±0.02 |
| BFM | 1.98±0.27 | 11.07±0.23 | 6.13±0.16 | 1.64±0.01 | 3.38±0.21 | 330.00±0.96 | 2.03±0.24 | 3.20±0.25 |
| RFM | 2.42±0.18 | 7.26±0.14 | 6.30±0.20 | 1.69±0.01 | 3.41±0.08 | 335.67±0.27 | 2.50±0.55 | 4.24±0.24 |
| US | 1.60±0.10 | 10.53±0.07 | 10.47±0.33 | 3.10±0.20 | 1.80±0.10 | 22.00±1.10 | 1.90±0.83 | 5.00±0.04 |
| GS | 1.88±0.07 | 8.70±0.10 | 12.40±0.20 | 2.53±0.06 | 2.70±0.10 | 30.99±0.06 | 1.77±0.82 | 7.00±0.01 |
| BS | 1.93±0.07 | 10.60±0.20 | 9.93±0.06 | 2.87±0.13 | 2.02±0.02 | 19.94±0.92 | 1.90±0.24 | 3.47±0.27 |
| RS | 2.02±0.06 | 7.70±0.10 | 10.93±0.06 | 3.33±0.26 | 1.70±0.10 | 24.00±0.25 | 2.28±0.57 | 5.00±0.22 |
| UW | 1.20±0.20 | 11.13±0.27 | 11.00±0.10 | 1.90±0.10 | 2.47±0.13 | 38.03±1.09 | 2.00±0.81 | 3.00±0.02 |
| GW | 1.60±0.20 | 10.90±0.10 | 12.47±0.13 | 1.53±0.06 | 2.97±0.03 | 46.00±0.08 | 3.07±0.83 | 4.50±0.03 |
| BW | 0.99±0.01 | 11.57±0.33 | 10.47±0.13 | 1.75±0.04 | 2.50±0.40 | 35.00±0.90 | 1.87±0.25 | 2.63±0.28 |
| RW | 1.47±0.03 | 10.00±0.30 | 11.87±0.13 | 1.53±0.06 | 2.50±0.10 | 40.01±0.26 | 3.00±0.59 | 2.93±0.26 |

UPM: Untreated pearl millet, GPM: Germinated pearl millet, BPM: Blanched pearl millet, RPM: Roasted pearl millet, UFM: Untreated finger millet, GFM: Germinated finger millet, BFM: Blanched finger millet, RFM: Roasted finger millet, US: Untreated sorghum, GS: Germinated sorghum, BS: Blanched sorghum, RS: Roasted sorghum, UW: Untreated wheat, GW: Germinated wheat, BW: Blanched wheat and RW: Roasted wheat.

10.17±0.22 mg/100 g, respectively. In untreated pearl millet carbohydrate was 71.53±0.08,72.78±0.28 in germinated and 74.67±0.14 in roasted millet flour. Kulthe *et al.* (2022) also observed carbohydrate was high in roasted followed by germination flour.

Finger millet exhibited substantially higher calcium levels compared to other millets, ranging from 330.00±0.96 to 355.67±0.07 mg/100 g, with the highest value observed in germinated finger millet. Protein content varied from 6.13±0.16% (blanched) to 10.13±0.26% (germinated), while fat content remained low across treatments (1.45±0.01–1.86±0.04%). Derbew and Moges (2017) reported the rise in protein level of millet after germination. Fiber content was comparatively higher in finger millet (3.08±0.11–3.84±0.16%), particularly after germination.

Protein content ranged from 9.93±0.06 to 12.40±0.20% in sorghum. Germinated sorghum showed the highest value of protein. Fat content varied modestly (2.53±0.06–3.33±0.26%), while fiber content ranged from 1.70±0.10 to 2.70±0.10%. Calcium levels were comparatively lowers (19.94±0.92–30.99±0.06 mg/100 g). The wheat control samples showed protein values between 10.47±0.13 and 12.47±0.13%, low fat content (1.53±0.06–1.90±0.10%), and moderate calcium levels (35.00±0.90–46.00±0.08 mg/100 g). Kumar *et al.* (2021) had reported an increase in crude fiber content with germination.

Overall, finger millet demonstrated superior calcium and fiber contents in a consistent manner and confirming millet type as the major determinant of nutritional variability, with processing treatments exerting nutrient-specific effects. Roasting tended to increase fat content and reduce moisture in millets. The germination generally improved fiber, protein, and mineral contents.

The objective of the MANOVA was to test the interaction effect of the type of millet (pearl, finger and sorghum) and treatment methods (raw/untreated, germination, blanching and roasting) on the proximate composition of millets which consisted of protein, fat, moisture, ash, carbohydrates, iron, calcium, zinc and fiber. The variables of millet type and treatment were regarded as constants and the proximate composition parameters were the dependent variables. The analysis was done using mean values of each parameter (Tables 2 and 3).

Test outcomes revealed that there was a statistical significance of the overall MANOVA model and thus the combination of the independent variables had a net effect on the proximate composition of millets. The multivariate treatment effect was also not found to be statistically significant as shown by the Pillai of Trace of 0.776, Wilks Lambda of 0.224, Hotelling Trace of 3.468 and Roy Largest Root of 3.468, and the level of significance of 0.506 and F value of 1.156. This outcome meant that the various treatments of processing did not present statistically significant multivariate outcome on the general proximate composition when all the

**Table 2.** Multivariate analysis of proximate composition of millets

| Effect | | Multivariate tests[a] | | | | |
|---|---|---|---|---|---|---|
| | | Value | F | Hypothesis d.f. | Error d.f. | Sig. |
| Intercept | Pillai's Trace | 1.000 | 473844.045[b] | 9.000 | 3.000 | .000 |
| | Wilks' Lambda | .000 | 473844.045[b] | 9.000 | 3.000 | .000 |
| | Hotelling's Trace | 1421532.135 | 473844.045[b] | 9.000 | 3.000 | .000 |
| | Roy's Largest Root | 1421532.135 | 473844.045[b] | 9.000 | 3.000 | .000 |
| Treatment | Pillai's Trace | .776 | 1.156[b] | 9.000 | 3.000 | .506 |
| | Wilks' Lambda | .224 | 1.156[b] | 9.000 | 3.000 | .506 |
| | Hotelling's Trace | 3.468 | 1.156[b] | 9.000 | 3.000 | .506 |
| | Roy's Largest Root | 3.468 | 1.156[b] | 9.000 | 3.000 | .506 |
| Millet | Pillai's Trace | 2.865 | 11.788 | 27.000 | 15.000 | .000 |
| | Wilks' Lambda | .000 | 148.820 | 27.000 | 9.404 | .000 |
| | Hotelling's Trace | 67389.575 | 4159.850 | 27.000 | 5.000 | .000 |
| | Roy's Largest Root | 67294.209 | 37385.672[c] | 9.000 | 5.000 | .000 |

[a] Design: Intercept+Treatment+Millet
[b] Exact statistic
[c] The statistic is an upper bound on F that yields a lower bound on the significance level.

**Table 3.** Test of between-subjects effect

| Source | Dependent variable | Type III sum of squares | d. f. | Mean square | F | Sig. |
|---|---|---|---|---|---|---|
| Corrected model | Protein | 43.101[a] | 4 | 10.775 | 7.135 | .004 |
| | Fat | 27.231[b] | 4 | 6.808 | 67.878 | .000 |
| | Moisture | 8.726[c] | 4 | 2.182 | .952 | .471 |
| | Ash | 1.697[d] | 4 | .424 | 10.086 | .001 |
| | Carbohydrates | 87.359[e] | 4 | 21.840 | 11.303 | .001 |
| | Iron | 86.360[f] | 4 | 21.590 | 18.082 | .000 |
| | Calcium | 279119.380[g] | 4 | 69779.845 | 1932.081 | .000 |
| | Zinc | 2.445[h] | 4 | .611 | 2.020 | .161 |
| | Fiber | 5.256[i] | 4 | 1.314 | 32.558 | .000 |
| Intercept | Protein | 348.615 | 1 | 348.615 | 230.837 | .000 |
| | Fat | 13.455 | 1 | 13.455 | 134.155 | .000 |
| | Moisture | 233.314 | 1 | 233.314 | 101.819 | .000 |
| | Ash | 9.869 | 1 | 9.869 | 234.564 | .000 |
| | Carbohydrates | 15038.525 | 1 | 15038.525 | 7783.178 | .000 |
| | Iron | 110.553 | 1 | 110.553 | 92.590 | .000 |
| | Calcium | 36807.267 | 1 | 36807.267 | 1019.128 | .000 |
| | Zinc | 22.446 | 1 | 22.446 | 74.181 | .000 |
| | Fiber | 24.402 | 1 | 24.402 | 604.587 | .000 |
| Treatment | Protein | 4.479 | 1 | 4.479 | 2.966 | .113 |
| | Fat | .886 | 1 | .886 | 8.836 | .013 |
| | Moisture | .232 | 1 | .232 | .101 | .756 |
| | Ash | .022 | 1 | .022 | .533 | .480 |
| | Carbohydrates | .533 | 1 | .533 | .276 | .610 |
| | Iron | 2.768 | 1 | 2.768 | 2.318 | .156 |
| | Calcium | 169.682 | 1 | 169.682 | 4.698 | .053 |
| | Zinc | .496 | 1 | .496 | 1.640 | .227 |
| | Fiber | .662 | 1 | .662 | 16.414 | .002 |
| Millet | Protein | 38.621 | 3 | 12.874 | 8.524 | .003 |
| | Fat | 26.345 | 3 | 8.782 | 87.559 | .000 |
| | Moisture | 8.494 | 3 | 2.831 | 1.236 | .343 |
| | Ash | 1.675 | 3 | .558 | 13.270 | .001 |
| | Carbohydrates | 86.826 | 3 | 28.942 | 14.979 | .000 |
| | Iron | 83.592 | 3 | 27.864 | 23.336 | .000 |
| | Calcium | 278949.697 | 3 | 92983.232 | 2574.541 | .000 |
| | Zinc | 1.949 | 3 | .650 | 2.147 | .152 |
| | Fiber | 4.594 | 3 | 1.531 | 37.939 | .000 |
| Error | Protein | 16.612 | 11 | 1.510 | | |
| | Fat | 1.103 | 11 | .100 | | |
| | Moisture | 25.206 | 11 | 2.291 | | |
| | Ash | .463 | 11 | .042 | | |
| | Carbohydrates | 21.254 | 11 | 1.932 | | |
| | Iron | 13.134 | 11 | 1.194 | | |
| | Calcium | 397.281 | 11 | 36.116 | | |
| | Zinc | 3.328 | 11 | .303 | | |
| | Fiber | .444 | 11 | .040 | | |
| Total | Protein | 1740.918 | 16 | | | |
| | Fat | 151.323 | 16 | | | |
| | Moisture | 1515.605 | 16 | | | |
| | Ash | 56.330 | 16 | | | |
| | Carbohydrates | 91323.184 | 16 | | | |
| | Iron | 585.035 | 16 | | | |
| | Calcium | 473832.321 | 16 | | | |
| | Zinc | 106.374 | 16 | | | |
| | Fiber | 111.379 | 16 | | | |
| Corrected total | Protein | 59.713 | 15 | | | |
| | Fat | 28.335 | 15 | | | |
| | Moisture | 33.932 | 15 | | | |
| | Ash | 2.160 | 15 | | | |
| | Carbohydrates | 108.613 | 15 | | | |
| | Iron | 99.494 | 15 | | | |
| | Calcium | 279516.660 | 15 | | | |
| | Zinc | 5.774 | 15 | | | |
| | Fiber | 5.700 | 15 | | | |

[a] $R^2$ = .722 (Adjusted $R^2$ = .621)
[b] $R^2$ = .961 (Adjusted $R^2$ = .947)
[c] $R^2$ = .257 (Adjusted $R^2$ = -.013)
[d] $R^2$ = .786 (Adjusted $R^2$ = .708)
[e] $R^2$ = .804 (Adjusted $R^2$ = .733)
[f] $R^2$ = .868 (Adjusted $R^2$ = .820)
[g] $R^2$ = .999 (Adjusted $R^2$ = .998)
[h] $R^2$ = .423 (Adjusted $R^2$ = .214)
[i] $R^2$ = .922 (Adjusted $R^2$ = .894)

dependent variables were taken collectively. Millet type, on the other hand, was found to have a large effect on all multivariate test statistics. Trace value of 2.865 of Pillai, Wilks Lambda of 0.001.

Trace of 67389.575 by Hotelling as well as Largest Root of 67294.209 by Roy with statistically significant F values and significance values of less than 0.001, was a clear indication that there was a significant difference in the proximate composition of millets of pearl millet, finger millet and sorghum when jointly dependent variables were taken into account.

After the multivariate findings, between subjects effects of univariate tests were tested to characterize particular proximate composition parameters added to these differences. The model was found to be statistically significant on protein, fat, ash, carbohydrates, iron, calcium and fiber meaning that a combination of the type of millet and treatment used was significant in explaining a considerable share of variance in these parameters. But the corrected model was not significant with moisture and zinc implying that these elements were not well explained by the model.

The treatment effect univariate results showed that the processing methods showed a statistically significant effect on fat and fiber content. The treatment effect on fat content was significant with a significance level of 0.013 and an F value of 8.836 and so was the treatment effect on fiber content which had a significant level of interest in the form of the significance level of 0.002 and an F value of 16.414. Conversely, treatment failed to demonstrate the statistically significant influence on protein, moisture, carbohydrates, ash, iron, calcium, or zinc, which means that the specified nutrients did not change significantly as a result of using various processing techniques on an individual basis.

Univariate analysis of millet type revealed statistically significant difference between millets on protein, fat, ash, carbohydrates, iron, calcium and fiber. The level of protein content was also highly different among the types of milled, as the level of significance of 0.003 and F value of 8.524 was significant. The millet effect was very strong on the fat content with an F value of 87.559 and a significant level of 0.001. In a similar manner, there were very significant differences in ash, carbohydrates, iron, calcium, and fiber among millets with calcium being the most significant as it had an extremely big F value and a significance value of less than 0.001. Nevertheless, there was no significant difference in moisture and zinc contents across the types of millet which indicated that moisture and zinc were relatively similar across pearl millet, finger millet and sorghum.

The value of $R^2$ pointed out that most of the proximate composition parameters were explained by the model especially the fat, carbohydrates, iron, calcium and fiber hence the model was robust in explaining the nutritional variation across the millets.

## CONCLUSION

The current study has shown that processing treatments play significant role in influencing the nutritional and functional properties of millets. Germination, roasting and blanching influenced the bioavailability of nutrients and overall proximate composition of grains of millet and increased the availability of the minerals and protein digestibility. The results indicated that the effect of processing was treatment-specific and millet-specific which explained the importance of selecting and optimizing the processing conditions. The findings were useful in the design of nutritionally enhanced, value-added millet foods that met the need of the increasing gluten free, healthy and sustainable foods making them more applicable in the household and commercial food processing. The findings also indicated that selective use of traditional processing might be used to fortify selected nutritional properties without causing significant changes in the nutritional profile of millets.

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