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# Effect of Pretreatments on Nutritional Composition of Sorghum, Green Gram and Ragi

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**ABSTRACT: The sorghum, ragi and green gram are some commonly used but very nutritious ingredients of many food products. The combinations of these ingredients can be used to improve specific or overall quality of diet or processed products. Each of the selected material has some nutritional advantage but they may have some challenges in their use. So various pretreatments are given to them to remove antinutritional factors, to make them more nutritious and digestible, to facilitate their milling etc.**

**The locally available varieties of selected materials were collected from the local market of Marathwada region of Maharashtra and analysed methodologically by using standard AOAC (2005) methods and proximate analysis of samples was carried out. Trypsin inhibitor activity of green gram was measured according to the procedure of Roy and Rao (1971) and Phytate content was determined by procedure elaborated by Haug and Lantzsch (1983).**

**The study was carried out to analyse effect of different pre-treatments like soaking and malting on proximate compositions of raw materials like sorghum, ragi and green gram. The findings revealed that soaking (8 hrs) and drying (60ºC) tend to increase moisture, carbohydrate and ash contents of sorghum. Malting of green gram caused significant increase in protein content from 22.74% to 25.17% and in crude fibre from 3.97% to 4.43%. Whereas, malting of ragi showed increase in fat content from 1.2% to 1.47%, in protein content from 8.10% to 9.11%, in carbohydrates from 70.80% to 80%. Also malting helped in reduction of antinutrional content of green gram. Phytic acid reduced by 31% and trypsin inhibitor activity decreased by 49%. The locally available varieties were collected and analysed methodologically by using standard AOAC (2005) methods for proximate analysis.**

**Keywords:** Pre-treatment, soaking, malting, sorghum, green gram, ragi.

## INTRODUCTION

The sorghum, ragi and green gram are some generally used staple foods. The cereals and pulses together forms complete food for human beings. Each of the selected ingredient has some nutritional advantage and the use of various combinations of them can help to reduce problem of malnutrition.

Conditioning of cereals is the adjustment of the moisture content by adding or removing moisture from them, so sorghum is soaked and dried before milling and then the prepared sorghum flour is used in various preparations. Likewise, green gram has high protein content and when it is malted, it becomes easy to digest by all people and improvement in nutritional quality is achieved. Malting of ragi also shown positive effect on nutritional values.

Legumes are generally good sources of proteins and contain on an average from 18 to 25 percent. Cereals are typically low in protein and are deficient in some essential amino acids, particularly lysine and tryptophan. Legumes are rich in protein and lysine, although they are limiting in sulphur containing amino acids. The blend of cereals and legumes forms the complete food which increases the protein content of the blend and protein quality through mutual complementation of their individual amino acids (WHO, 2001). Starch is the prominent stored carbohydrate followed by dietary fibre, simple sugars and oligosaccharides. Calcium, magnesium, potassium, phosphorus and iron also are present in the legume seeds. The treatments like soaking, sprouting and fermentation improve the bioavailability of nutrients. Legume consumption also reduces the risk of some cancers (colon, breast and prostate) and also manages weight, because of its satiety value (Kamboj and Nanda, 2017).

Sorghum (*Sorghum bicolour* L.) is crucial element of weaning foods of infants and convalescents due to its high caloric value and significant presence of some minerals (FAO, 2011). Sorghum is equal or better than wheat or rice in some aspects of nutritional value. Sorghum has considerable amounts of proteins, lysine, lipids, carbohydrates, fibre, calcium, phosphorus, iron, thiamine and niacin (Shobha *et al*., 2008; Chavan *et al*., 2009). Sorghum is safe for people allergic to gluten (Vikas, 2003).

Finger millet, also known as ragi (Takhellambam *et al*., 2016) or tamba (Jideani, *et al.*, 1996) is consumed without dehulling (Gull *et al*., 2015). The grains are staple cereal food in some parts of Africa and India (Saleh *et al*., 2013; Siwela *et al*., 2010). Although a gluten-free grain with a low-glycaemic index with nutritional and nutraceutical advantages, Finger Millet is neglected and underutilized (Amadou *et al*., 2013; Jideani and Jideani, 2011).

Green gram *(Vigna radiata* L.) seeds are more digestible than other pulses because they have lower content of raffinose, stachyose and oligosaccharides associated with the flatulence and intestinal disorders. Sprouting have great influence on the nutritional quality because it enhances bioavailability of nutrients as well as improves the digestibility and usage of nutrients (Tilekar *et al*., 2019).

The sorghum as well malted green gram and finger millet are widely used for complementary feeding of weaning children, so the advantages of the malts are investigated by various scientists.

The digestibility, sensory and nutritional quality of finger millet gets increased and level of antinutritional factors is decreased after malting (Pawar and Dhanvijay, 2007). During malting the grains develop enzymes including diastatic enzymes that are required to modify starch into sugars, including monosaccharides such as sucrose or maltose. Other enzymes are also developed like proteases, which convert proteins present in grain. The quality of grains also improves due to removal of undesirable components such as antinutritional factors (Verma *et al.,* 2012). Soaking of sorghum increases moisture, carbohydrate, ash and vitamin C content with a decreases in other parameters. The increase in moisture content was due to the uptake of water during soaking. The reason for an increase in ash content is considered to be apparently the loss of starch, while a decrease can be attributed to leaching losses during soaking (Kale *et al.,* 2019).

## MATERIALS AND METHODS

The present investigation was carried out in Department of Food Process Technology, College of Food Technology, VNMKV, Parbhani during year 2020-21.

*A. Materials*

The good quality of sorghum, ragi and green gram were procured from Parbhani local market.

**Chemicals and Glasswares.** Chemicals of analytical grade and glasswares used during study was available in the department of Food Process Technology, College of Food Technology VNMKV Parbhani.

*B. Methods*

**Analytical methods.** The grains were analysed for the chemical composition namely moisture, protein, fat, ash, crude fibre and minerals composition were carried out as per the method given by (AOAC, 2005). Nutrients were analysed in duplicate and results were expressed on dry weight basis.

**Proximate analysis.** Different chemical properties of samples were analysed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done in triplicate and the results were expressed as the average value.

**Moisture content.** Moisture content was determined as per the method given by AOAC (2005). It was calculated using following formula:

$$\% \text{ Moisture content} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \times 100$$

*Fat.* AOAC (2005) method using Soxhlet apparatus was used to determine crude fat content of the sample. The percent of crude fat was expressed as follows:

$$\% \text{ Crude Fat} = \frac{\text{Weight of oil}}{\text{Weight of sample}} \times 100$$

*Protein.* Protein content was determined using AOAC (2005) method. Percentage of nitrogen and protein calculated by the following equation:

$$\% \text{ Nitrogen} = \frac{\text{TS} - \text{T}_\text{B} \times \text{Normality of acid} \times 0.014}{\text{Weight of sample}} \times 100$$

Where, Ts = Titre volume of the sample (ml),
TB = Titre volume of Blank (ml), 0.014= M eq. of N
% Protein = Nitrogen × 6.25

*Total carbohydrate.* Total carbohydrate content of the samples was determined as total carbohydrate by difference that is by subtracting the measured protein, fat, ash and moisture from 100.

*Ash.* Drying the sample at 100ºC and churned over an electric heater. It was then ashes in muffle furnace at 550ºC for 5 hrs. It was calculated using the following formula:

$$\% \text{ Ash content} = \frac{\text{Weight of ash}}{\text{Initial Weight of sample}} \times 100$$

*C. Anti-nutritional compounds analysis*

**a) Trypsin inhibitor activity.** Trypsin inhibitor activities of legume samples were measured according to the procedure of Roy and Rao (1971).

**b) Phytate content.** Phytate content in legume meals was determined by procedure elaborated by Haug and Lantzsch (1983).

*D. Preparation of sorghum flour*

The sorghum flour was formulated using the method described by Ebunoluwa *et al*., (2017). The grains were soaked in clean water for 8 hrs and the water was decanted after soaking. The drying of grains was done in a cabinet dryer at 70°C for 8 hrs. The dried sorghum was milled into flour using a laboratory hammer milling machine and the milled sample was sieved (using the 60 mesh screen) to obtain the flour. The sorghum flour was packed and sealed in polyethylene bags at ambient temperature (26 ± 2°C) until further analysis.

*E. Preparation of ragi malt*

Finger millet grains were cleaned to remove impurities and soaked in water for 12 h. Excess water was decanted and then soaked grains were wrapped in gunny cloth and allowed to germinate for two days. Water was regularly sprinkled during germination to keep grains moist. Sprouted grains were kiln in drier, rootlets were removed, decorticated and powdered as indicated by Shobana and Malleshi (2007).

*F. Preparation of green gram malt*

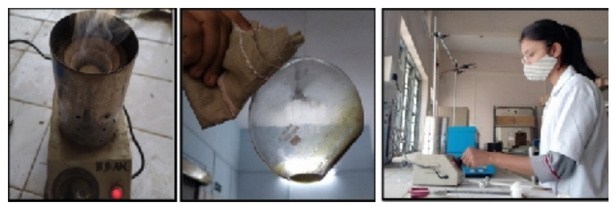
The green gram seeds were cleaned by washing three times in excess distilled water. Then, the green gram seeds were soaked in a volume of water three times the weight of seeds (3:1) in a container at ambient temperature for 12 h. The steeping water was removed off and the soaked green gram seeds were washed twice using distilled water to avoid the growth of microorganisms during sprouting. To stimulate sprouting, the soaked seeds were wrapped in damp muslin cloth. The green gram seeds were allowed to sprout for 24 h time. The content was left in ambient conditions and water sprinkled on it 2-3 times a day to enhance the speed of sprouting process. The sprouts were dried overnight at room temperature under a fan. The sprouted grains were ground in an electric grinder and converted to fine powder and sieved by 80-100 mesh size as explained by Bazaz *et al*., (2016). But only change was made that the sprouts were dried in cabinet drier at 60-65°C for 6-8 h to speed up the drying in a controlled environment.

## RESULTS AND DISCUSSION

*A. Effect of pre-treatments on proximate composition of sorghum, green gram and ragi*

**Effect of soaking on proximate composition of sorghum.** Soaking is important treatment for sorghum to adjust the moisture content and make the suitable for milling.

The sorghum was soaked for 8 hours and then dried at 60°C for 6 hours to obtain best results. Results from Table 1 show that mean value for moisture, fat, protein, carbohydrate, ash, crude fibre of raw and soaked sorghum varied between 10.1 to 12%, 1.8 to 1.67%, 10.4 to 7.90%, 74.4 to 75.5%, 2.1 to 2.4%, 1.3 to 1.19%, respectively. These values assure that soaking caused increase in moisture, carbohydrate and ash content of sorghum but showed decrease in fat protein and fibre content of sorghum.



Kale *et al.,* (2019) followed this method and found that mean value for moisture, fat, carbohydrate, protein, ash, crude fibre, iron and vitamin C content of raw and soaked sorghum varied between 9.9 to 11.8%, 1.9 to 1.75%, 73.5 to 74.45%, 10.9 to 8.2%, 2.3 to 2.5%, 1.5 to 1.3%, 4.4 to 4mg/100g, 0.6 to 1.2mg/100g respectively. Similar results also depicted by (Onoja *et al.*, 2014; Singh *et al.*, 2018).

**Table 1: Effect of soaking on proximate composition of sorghum.**

| Parameters | Raw sorghum | Soaked sorghum |
|---|---|---|
| **Moisture (%)** | 10.1 ± 1.0 | 12.0 ±0.30 |
| **Crude fat (%)** | 1.8 ± 0.05 | 1.67±0.01 |
| **Protein (%)** | 10.4 ±0.42 | 7.90±0.11 |
| **Carbohydrates (%)** | 74.4 ± 0.50 | 75.5±0.50 |
| **Ash (%)** | 2.10 ± 0.01 | 2.40±0.01 |
| **Crude fibre (%)** | 1.3 ± 0.02 | 1.19±0.02 |

*Each value is an average of three determinations

**Effect of malting on proximate composition of green gram.** The green gram malt showed decrease in moisture content from 9.96% to 8.70%, in fat content from 1.73% to 1.41%, in carbohydrates from 57.54% to 56.71%, in ash from 3.98% to 3.61% as compared to raw green gram. Also green gram malt showed increase in protein content from 22.74% to 25.17%, in crude fibre from 3.97% to 4.43%. The findings were in agreement with (Tilekar *et al*., 2019). Murugkar *et al*., (2013) noticed the effect of sprouting during malting also and stated that crude protein content of sprout mixes was higher (22.5 to 24.8 %) than the unsprouted mixes. Fat content to be decreased in the 9 hrs soaked malt sample this may be because of total solid loss during 9 hrs soaking prior to sprouting and malting. Also this decrease of fat content on sprouting and malting mainly occurred by their utilization as energy source in the sprouting process (Wang *et al.*, 1997).

**Table 2: Effect of malting on proximate composition of green gram.**

| Parameters | Raw Green Gram | Green gram malt |
|---|---|---|
| **Moisture (%)** | 9.96 ± 0.07 | 8.70±0.20 |
| **Crude fat (%)** | 1.73 ± 0.05 | 1.41±0.03 |
| **Protein (%)** | 22.74 ± 0.3 | 25.17±0.4 |
| **Carbohydrates (%)** | 57.54 ± 0.9 | 56.71±0.60 |
| **Crude fibre (%)** | 3.97 ± 0.01 | 4.43±0.12 |
| **Ash (%)** | 3.98 ± 0.02 | 3.61±0.04 |

*Each value is an average of three determinations

**Effect of malting on proximate composition of ragi.** The effect of malting on ragi also showed decrease in moisture content from 13.2% to 6.70%, in fibre content from 4.0% to 2.48%, in ash from 2.90% to 2.03%, as compared to raw ragi. Ragi malt showed increase in fat content from 1.2% to 1.47%, in protein content from 8.10% to 9.11%, in carbohydrates from 70.80% to 80%. The findings were in agreement with (Mushtari *et al.*, 2016). Soubhagyalakshmi and Geetha (2019) also studied five varieties of finger millet namely GPU 66, GPU 67, GPU 71, MR 6 and PR 202 were investigated for their nutritional contents before and after processing such as malting and popping (Table 3).

**Effect of malting on antinutritional factors of green gram.** The data related to antinutritional factors of non-germinated and germinated green gram was determined and results obtained and illustrated in Table 4.

Phytic acid and trypsin inhibitor are major antinutritional factors found in raw green gram. It becomes necessary to reduce their content before consuming it. Trypsin inhibitor activities of legume samples were measured according to the procedure given by Roy and Rao, (1971). Phytate content in legume meals was determined by procedure elaborated by Haug and Lantzsch, (1983). Germinated green gram showed 31% reduction in phytic acid content and 49% reduction in trypsin inhibitor activity as compared to raw green gram. The results are in range with Kakati *et al.*, (2010).

**Table 3: Effect of malting on proximate composition of ragi.**

| Parameters | Raw Ragi | Ragi malt |
|---|---|---|
| **Moisture (%)** | 13.2 ± 0.7 | 6.70±0.20 |
| **Crude fat (%)** | 1.2 ± 0.1 | 1.47±0.01 |
| **Protein (%)** | 8.1 ± 0.04 | 9.11±0.23 |
| **Carbohydrates (%)** | 70.8 ± 2.0 | 80±0.30 |
| **Crude fibre (%)** | 4.0 ± 0.05 | 2.48±0.04 |
| **Ash (%)** | 2.9 ± 0.01 | 2.03±0.01 |

*Each value is an average of three determinations

**Table 4: Antinutritional factors of raw and malted green gram flour.**

| Constituents | Raw green gram | Malted green gram | % Reduction |
|---|---|---|---|
| Phytic acid content (mg/100 g) | 670±13 | 462±15 | 31% |
| Trypsin inhibitor activity (TIU/100g) | 2532±20 | 1315±17 | 49% |

*Each value is average of three determinations

## CONCLUSION

Overall it can be concluded that the malting is effective in reducing antinutritional compounds which allows to use malts in specific use products like complementary foods, geriatric foods etc. Malting also helps to improve digestibility of proteins and carbohydrates by converting them to their simple forms. Also the reduction in of content after sprouting and malting mainly related to its utilization as energy source in the sprouting process. Soaking helps to adjust moisture content of sorghum for milling i.e. conditioning.

## FUTURE SCOPE

The effects of other pretreatments can be studied in the future such as roasting, cooking etc. the malted flours of green gram and ragi can be used as ingredients for many products like weaning foods, geriatric foods, protein rich foods, protein bars and shakes etc. As ragi needs more time to get sprouted with soaking in cold water, the investigation by using luke warm and hot water or waters with different temperatures can be used.

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**Conflict of interest.** The author(s) declare that there is no conflict of interest.

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