WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 6, Issue 17, 694-705. Research Article ISSN 2277– 7105

PROXIMATE ANALYSIS OF PROCESSED PEARL MILLET FLOUR AND SENSORY EVALUATION OF ITS HOMESTEAD PRODUCTS

Dheera Patni*[1] and Dr. Mukta Agrawal[2]

[1]Research Schoolar, Department of Home Science, University of Rajasthan, Jaipur, Rajasthan.

[2]Associate Professor; Department of Home Science, University of Rajasthan, Jaipur, Rajasthan.

Article Received on 24 October 2017,
Revised on 14 Nov. 2017,
Accepted on 04 Dec. 2017
DOI: 10.20959/wjpr201717-10345

***Corresponding Author**
Dheera Patni
Research Schoolar, Department of Home Science, University of Rajasthan, Jaipur, Rajasthan.

ABSTRACT

Bajra or Pearl Millet (***Pennisetum Glaucum***) is one of the oldest millet used by our ancestors. It is an essential food crop in arid and semi arid dry regions of asia and Africa. Now bajra are recommended by many health professionals, Dieticians and Nutritionist because of its various health benefits. It is also not very expensive millet which can reduce its consumption but its use has been limited due to presence of anti nutritional compounds such as phenols and tannins that results poor digestibility and poor availability of nutrients. It has been reported the different processing treatments would reduced the amount of anti nutrients in food grains But the changes in the amount of important nutritional compounds with respect to the processing treatment such as milling and germination are yet not clear. Therefore the current research work objective was to estimate the effect of germination on some of the important nutritional qualities of Pearl millet. *Pearl Millet was processed and mineral, antinutritional analysis was performed.* Homestead Products (Vanilla cake and pearl millet idli) was developed from processed iron rich pearl millet flour. Sensory evaluation of the formulated products was done. Germination has been found to significantly increase the crude protein content high mineral availability of millet flour; thus advantage in weaning food formulations.

KEYWORDS: Pearl millet, Germination, Nutritional, Sensory evaluation, Proximate analysis.

1. INTRODUCTION

Pearl millet (P. glaucum (L.) R. Br.) *belongs to section* ***Paniceae*** *of family* ***Poaceae*** is commonly known as ***pearl millet*** in English and *bajra* in Hindi. It is the most important and probably has the greatest potential, of all millets. It is the robust, quick growing, most drought tolerant warm-season cereal crop grown as staple food grain and source of feed and fodder on about 30 M ha in the arid and semi-arid tropical regions of Asia and Africa. In India area under Bajara cultivation is 79.761 lakh hectare, production is 88.5 lakh tones with 1110 kg/ha productivity where as in Rajasthan bajra is cultivated on 8.85 lakh hectare, production is 7.6 lakh tones with productivity 859 kg/ha. (***AICPMIP, Annual Report, 2014***).

India is also the largest producer of pearl millet in the world in terms of area and production. (***Khairwal, 2008***). Along with Rajasthan, it is specifically adapted to grow on the most marginal, driest and least fertile cereal growing environments. Among the cereal crops, it has the highest water use efficiency under drought stress. It is the only major crop that has high levels of tolerance to both acid and saline soils. Pearl millet is largely grown on light textured soils in the annual in fall regime of 400-750 mm, where sorghum and maize often fail to produce any yield.

Pearl millet grains are not only nutritionally comparable but are also superior to major cereals with respect to protein, energy, vitamins and minerals. Besides they are rich source of dietary fibre, phytochemicals, micronutrients, neutraceuticals and hence, now a days they are rightly termed as "Nutria-cereals". However, the utilization of millets for food is still mostly confined to the traditional consumers and population of lower socio-economic strata, partly due to the non-availability of these grains in ready-to-use or ready to eat forms (***Malleshi and Desikachar, 1985***). Pearl millet grain contains 8.5-15% protein, 5.3-6.0% fat, 1.05-1.7% crude fibre and 65.5-70.0% nitrogen free extract (***Popli and Singh 1972***). ***Upreti and Austin*** (1972) compared 14 millet hybrids for proximate analysis and found that different hybrids grain were very rich in storage carbohydrates (59-69%) and proteins (11.31 to 19.62%). In pearl millet grains the percentage of crude protein is 7.02 to 13.67, fat 4.02 to 7.8, crude fibre 0.54 to 4.0 and ash content 0.25 to 2.54 percent as reported in various analytical studies (***Sehgal and Kawatra, 2006***).

The mineral content in pearl millet is higher than other cereals. The sodium, magnesium and copper in pearl millet are reported to be at par with wheat whereas potassium, phosphorus and iron are higher than wheat. Calcium content of pearl millet varieties ranges from 10.0 to

80.0 mg/100 and phosphorus content ranges from 185 to 990 mg/100 g, respectively. Iron content of pearl millet as reported by various studies varies from 4.0 to 18.0 mg/100g (***Sehgal and Kawatra, 2006****).*

It is an excellent forage crop because of its low hydrocynic acid content. The green fodder is rich in protein, calcium, phosphorous and other minerals with oxalic acid in safe limits. (***Athwal and Gupta 1966, Gupta 1975***). It is more digestible when fed green to animals rather than chaffed straw.

Pearl millet has some limitation, due to presence of anti nutritional compounds like tannins, phenols and phytate. These compounds are known to interfere with mineral bioavailabilty and protein and carbohydrate digestibility.

Nutritional quality of food is the most important parameter for maintaining human health and complete physical well being. Since nutritional well being is the driving force for development and maximization of human genetic potential. Dietary quality of food should be taken into consideration for maintaining overall maximization of human health and fitness to solving the problem of deep rooted malnutrition. Diversification of food production must be encouraged both at national and household level in tandem with increasing yields and household techniques. Some of the agricultural foods are not using as human main food because of unawareness of people. Millets are one of them. Millets are being used as animal and bird feed. Millet has many nutritious and medical functions reported.

Germination is one of the process that decreases the level of antinutrient and enhance the nutrient digestibility and improved the availability. Food uses of pearl millet are usually traditional and the methods of processing may involve boiling, roasting, pressure cooking or can be served raw after sprouting. Information on the effect of these simple processing methods on anti nutrients appears to be lacking.

Therefore the current research paper is aimed for Proximate Evaluation of Processed Pearl Millet Flour and Sensory Evaluation of its Homestead Products.

2. OBJECTIVES OF RESAERCH

This study would like to evaluate the effect of some processing methods on the proximate, antinutritional and functional properties of pearl millet flour, so as to consider its possible usage in other food system.

The objectives of current research study are:

- To study nutritional facts of ***Pearl Millet***.
- To prepare and nutritional evaluation of Processed ***Pearl Millet***.
- To develop and sensory ***Evaluation of Homestead Products of Processed Pearl Millet Flour.***

3. MATERIALS AND METHODS

3.1 PROCUREMENT OF RAW MATERIAL

The Raw material Pearl Millet (Sankar Bajra) was procured from Durgapura Agriculture Station, Jaipur. Every time the raw material in one variety was procured.

3.2 PREPARATION OF FLOURS

Germinated Millet Flour (GMF): About 500gm of millet grains were soaked the seeds overnight in water at room temperature. The seeds were placed on muslin cloth and left to sprout at room temperature for 24 hours. The sprouted seeds were then dried at 50^0C, the dried germinated seeds were milled to obtain the germinated millet flour (Fig.1).

Millet seeds

↓

Cleaning

↓

Soaking

↓

Draining

↓

Germination

↓

Drying

↓

Milling

↓

Millet flour

Fig. 1: Flowchart for the production of Germinated Millet Flour (GMF).

3.3 DETERMINATION OF MINERAL COMPOSITION

Na and K content of the processed flour samples were determined using flame photometry methods (AOAC, 1990). The concentrations of Ca, Fe and Zn were determined after wet digestion with a mixture of perchloric and nitric acid using atomic absorption spectro-photometry (AAS, model sp9, pye unicam, UK). While, P was estimated colorimetrically by the ammonium molybdate method (AOAC, 1990).

Carbohydrate percentage was calculated as follows:

%Carbohydrate = 100- (%moisture + % Protein + %Crude Fibre + %Fat + % Ash)

3.4 DETERMINATION OF ANTINUTRITIONAL FACTORS

Tannin content of the processed flour samples was determined as described by Makkar and Goodchild (1996), while the total phenolics content of the processed flour samples was determined using the method of Singleton and Lamuela (1999).

3.5 PRODUCT FORMULATION

Homestead Products (vanilla cake and Pearl millet idli) was developed from processed iron rich pearl millet flour. In all recipes of product will be standardization in terms of amount of ingredients, cooking procedures serving size.

3.6 SENSORY EVALUATION

The sensory evaluation was carried out by panel of 20 judges. The samples were ranked on a 9-point Hedonic scale with 1 representing dislike strongly and 7 like strongly. The samples were presented in a random pattern and judged in terms of texture, flavor, taste, appearance and over all acceptability. A glass of water was presented to rinse mouth in between each determination.

3.7 STATISTICAL ANALYSIS

Data collected were subjected to Analysis of Variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT).

4. RESULTS

Table 1 shows the Proximate Composition of Raw Millet Flour (RWMF) and Germinated Millet Flour (GMF) on dry weight basis. The protein content ranged from 14.0-18.7%. Significant increase ($p<0.05$) was observed in the crude protein content of the processed flours compared with the control. The highest increase was observed in the germinated millet flour (18.7%). The crude protein of the germinated millet flour is similar to value reported for fermented Treculia africana seed flour (Fasasi et al., 2004). The increase in protein of the germinated flour may be due to protein synthesis. Germination may be a desirable processing technique to increase the protein content of millet seed.

The carbohydrate content of control millet was 76.3%, which is greater than carbohydrate content of germinated millet flour (71.1%). Decrease in carbohydrate content of germinated seed flour may be due to the utilization of some of the sugars during the growth metabolic activity.

The fat content of processed millet flour ranged from 2.4-7.2%. The fat content obtained for Germinated Millet Flour (GMF) is 5.6%, which is less than the value reported for African breadfruit seed (11.39%) according to Fasasi or at (2004).

The ash content obtained for Germinated Millet Flour (GMF) is 2.1%. The ash content indicates a rough estimation of the mineral content of the product.

The crude fibre content of the samples ranged from 1.8-2.0%. The Raw Millet Flour (RWMF) has the highest fibre content while germinated has fibre content of 1.8%. The high crude fibre content in Germinated Millet Flour (GMF) may be due to sugar utilization in the seed for metabolic sprouting activity leaving fibrous seeds and enzymatic degradation of the fibre during fermentation (Ikenebornah of at, 1986). Similar observations have been reported for fluted pumpkin (Giaini and Bekebain, 1992) and cowpea (Padmashree of at, 1987).

Table 2 shows the mineral content of the raw and germinated. A significant reduction ($p< 0.05$) in total phosphorus and calcium contents was observed in all the processed millet flour samples when compared with the raw millet flour samples. The high phosphorus value Germinated Millet Flour may be due to the synthesis of phosphorus by phytase enzyme. Magnesium content decreased during germination treatments.

The K/ Na of processed millet flours ranged between 2.53 and 3.26. These values are greater than the recommended value of 1.0 (NRC, 1989) hence, the consumption of the processed flour could accompanied by salting with NaCl to enhance the balance of body fluids. Its consumption without salting with NaCl may lead to mineral imbalance in those fed solely on it (Bologun and Fetuga, 1986). According to Dogra *et al.* (2001), different processing methods reduce the mineral contents of pearl millet. The decrease in mineral content with germination might be due to metabolic loss and transfer of nutrients to the growing embryo (Slaullca *et al*., 1986).

Table 3 shows the anti-nutritional content of the samples. The Raw Millet Flour sample (RWMF) contains a high concentration of both tannin and total phenol and this was reduced by the processing methods. The germinated millet flour has 0.38 mg/100 g Tannin and 0.14 mg/100 g total phenol. Decrease in anti-nutritional factors during germination could be attributed to leaching of polyphenols in the soaking water (Jood et al., 1987) and increased enzymatic treatment during germination (Bishnoi et al., 1994).

Table 1: Proximate Composition of Raw and Geminated Pearl Millet Flour (Dry Weight Basis).

Samples	Moisture	Crude protein (%)	Fat (%)	Ash (%)	Crude fibre (%)	CHO (%)	Energy (kcal)
RWMF	7.22±1.3[b]	14.0±1.6[b]	5.7±0.34[ab]	2.1±0.03[ab]	2.0±0.04[a]	76.3	412
GMF	8.5±2.89[a]	19.4±1.54[a]	5.6±0.23[ab]	2.1±0.02[ab]	1.8±0.02[ab]	71.1	479

±Standard deviation of three replicates. Mean values followed by different superscript within column are significantly different at ($p>0.05$). **RWMF: Raw Millet Flour**, **GMF: Germinated Millet Flour**.

Table 2: Mineral Composition of Raw and Geminated Pearl Millet Flour (mg/100g).

Samples	P	Ca	Mg	Bio available iron	Fe	K	Na
RWMF	360	42	97	4.64	8.8	30	9.2
GMF	330	27	72	10.89	9.9	24	7.8

RWMF: Raw Millet Flour, **GMF: Germinated Millet Flour**.

Table 3: Antinutritional Factors in Raw And Geminated Pearl Millet Flour (Mg/100g).

Samples	Tannin	Total phenol	Oxalate Content
RWMF	0.51	0.21	0.18
GMF	0.38	0.14	0.68

RWMF: Raw Millet Flour, **GMF: Germinated Millet Flour**.

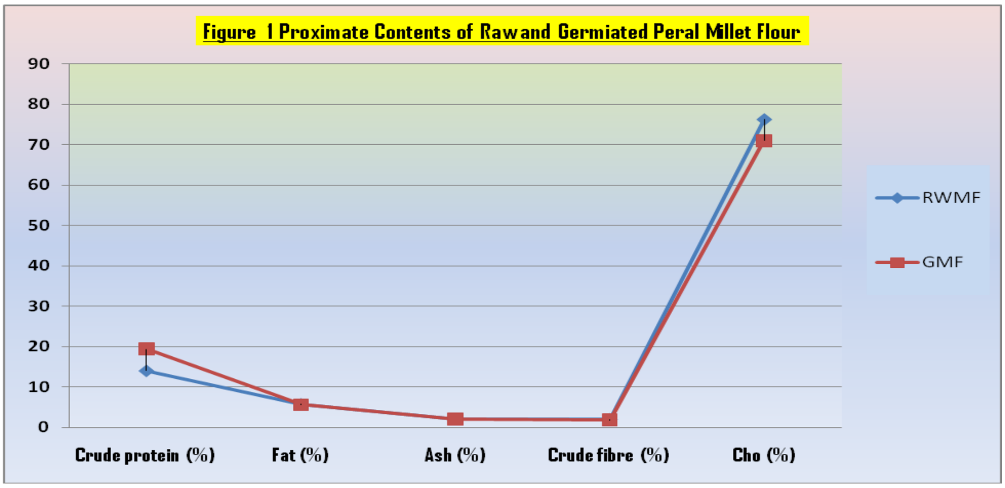


Figure 1 Proximate Contents of Raw and Germiated Peral Millet Flour

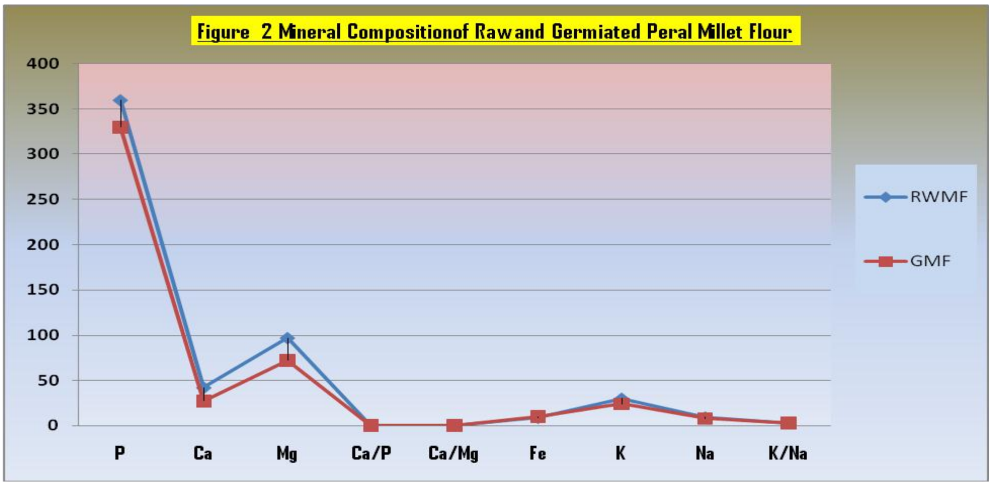


Figure 2 Mineral Compositionof Raw and Germiated Peral Millet Flour

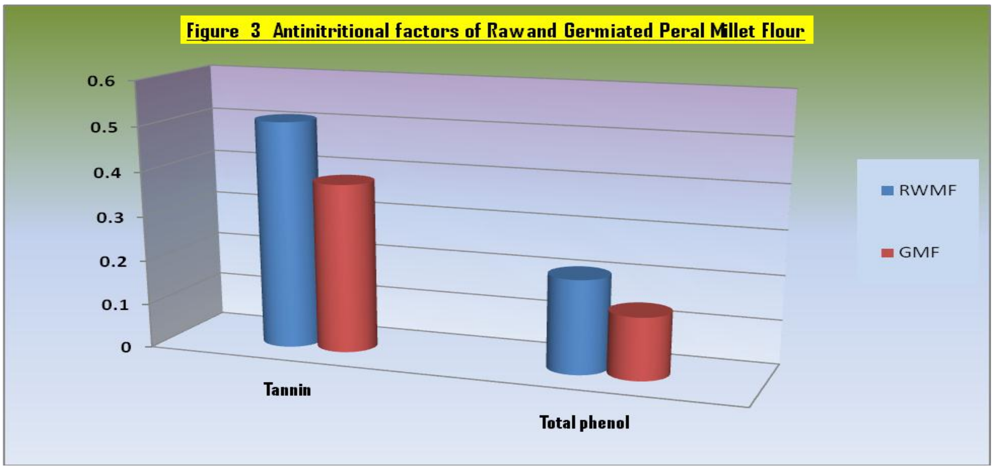
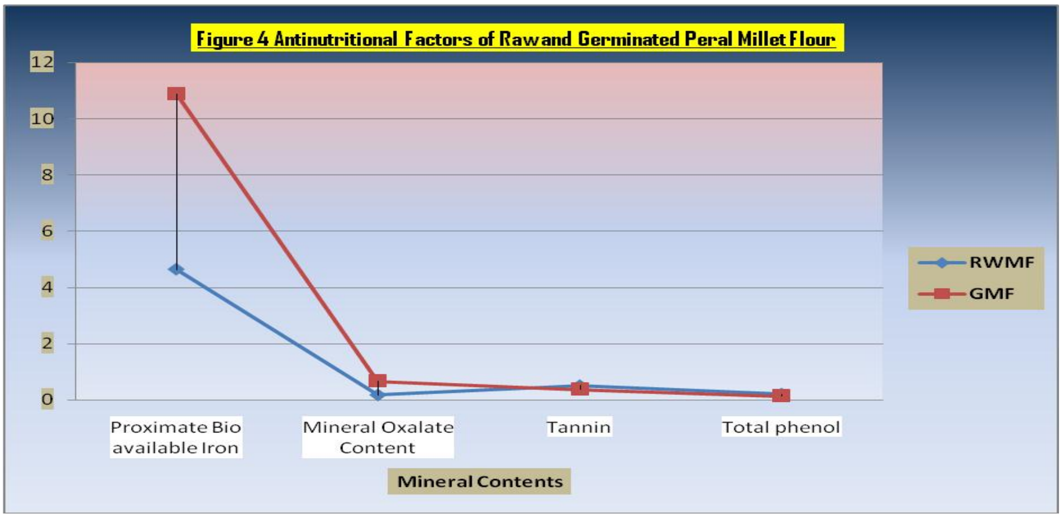


Figure 3 Antinitritional factors of Raw and Germiated Peral Millet Flour



Sensory Properties of the Homestead Products (vanilla cake and Idli) and the Control

The result (***Table 4***) of the sensory analysis showed that both the control and the test samples were not significantly (P>0.05) different in texture and flavor attributes. In taste, the test samples were found not significantly (P>0.05) different from each other however, significantly (P<0.05) high than the control (sample A). In appearance, samples A and C compared favorably with the control while sample B showed superiority in appearance. In the general acceptability, samples B and C were not significantly (P>0.05) different from each other but, significantly high than samples A and C. The result of the taste implies that, varying the proportion of the test ingredients had no influence. However, the taste of flour processed showed superiority over the control (non processed variety). Appearance, sample B received the highest acceptability. Possibly, the combination may favoured the appearance of the product. Unlike the control (sample A) which was made from unprocessed peral millet flour.

Table 4. Results of Sensory Properties of Homestead Products (Chapati & Rabdi) And The Control.

Sensory	Control (Sample A)	Homestead Products (vanilla Cake) Sample B	Homestead Products (Pearl millet idli) Sample C
Texture	$7.35^a \pm 1.56$	$8.10^a \pm 0.85$	$7.55^a \pm 1.14$
Taste	$6.95^b \pm 1.27$	$7.85^a \pm 0.81$	$7.70^a \pm 1.03$
Flavor	$7.35^a \pm 1.26$	$7.55^a \pm 0.94$	$7.35^a \pm 0.93$
Appearance	7.10b±1.37	$8.00^a \pm 0.85$	$7.30^b \pm 1.08$
0.A.	$6.70^b \pm 1.40$	$7.65^a \pm 0.67$	$7.20^b \pm 0.95$

- *Values are mean ±SD of duplicate determinations.*
- *Means in the same rows flooed by the same superscript are not significantly different (p≥0.05).*

- *Key: OA = Overall Acceptability.*

5. CONCLUSION

Dieticians and Nutritionist are trying their best to promote this particular millet and increase its consumption by educating its benefits among all groups of people. Awareness among the people helps to create a positive attitude towards this millet. It is also called as pearl millet. It is not expensive like pearl but it's definitely has pearl like quality which is beneficial to the body. 100 grams of bajra has the following nutritional values: energy 360 calories, moisture 12g, protein 12g, fat 5g, mineral 2g, fiber 1 g, carbohydrate 67g, Calcium 42mg, phosphorus 242mg and iron 8mg. By any nutritional parameter, millets are miles ahead of rice and wheat in terms of their mineral content, compared to rice and wheat. Each one of the millets has more fibre than rice and wheat.

Germination has been found to significantly increase the crude protein content of millet flour; the high protein content is of advantage in weaning food formulations. Germination also resulted in increased bio availability of nutrients like protein and minerals improved senory parameter, hence germinated millet flour would be of use in food systems where these properties are required.

REFRENCES

1. Adeola, O. and Orban, J. I., Chemical composition and nutrient digestibility of pearl millet (*Pennisetumglaucum*) fed to growing pigs. J Cereal Science, 1994; 22: 177- 184.
2. Akingbala, T.O., 1991. Effect of processing on flavonoids in millet (Pennisetum arnericcmurn). Care Chem., 68: 180-183.
3. Anoma Chandrasekara and Fereidoon Shahidi., Bioactivities and Antiradical AOAC, 1990. Official Method of Analysis. 14th Edn. Association of Official Analytical Chemists, Washington, DC.
4. Balogun, A.M. and B.L. Fetuga, 1986. Chemical composition of some underexploited Leguminous crop seed in Nigeria. J. Agric. Food Chem., 34: 189-192.
5. Bishnoi, S., N. Knetarpaul and R.K. Yadav, 1994. Effect of domestic processing and cooking methods on phytic acid and polyphenol contents of pea cultiva (Pisurn sativum). Plant Food for Hum. Nutr., 47: 381-388.
6. Camara, E. and M.A. Amami, 2003. Nutritional aspect of zinc availability. Int. I. Food Sci. Nutr., 54: 143-1 51.

7. Crawford, Gary W. and Gyoung-Ah Lee (2003). "Agricultural Origins in the Korean Peninsula". *Antiquity*, 77(295): 87–95. doi:10.1017/s0003598x00061378
8. Del Rosario, R.R. and D.M. Flores, 1987. Functional properties of four types of mung beans flour. J. Sci. Food Agric., 32: 175-180.
9. Dogra, I., Y. S. Dhaliwal and. M. Kalia, 2001. Effect of soaking, germination, heating and roasting on the chemical composition and nutritional quality of soybean and its utilization in Indian leavened products. J. Food Sci. Technol., 38: 453-457.
10. DoMD, "Area and Production analysis of millets in India", Directorate of Millets Development (DoMD), Ministry of Agriculture and Cooperation, Government of India, downloaded on 25th July 2009 from http://dacnet.nic.in/millets/all_india_apy_trend.htm
11. Fagbemi, T.N., 2008. Effect of processing on the functional properties of of full-fat and defatted cashew nut (.4nacarclizem occidentale) seed flours. J. Food Sci. Technol., 45(1): 28-35.
12. Fasasi, 0.5., A.F. Eleyinrni, A.R. Fasasi and O.R. Karim, 2004. Chemical properties of raw and processed breadfruit (Treculia africana) seed flour. J. Food Agric. Environ., 2(1): 65-68.
13. Fasasi, 0.S., A.F. Eleyinrni and M.A. Oyarelcua, 2005. Effect of some traditional processing operations on the functional properties of African breadfruit (Trecutia africana) seed. LWT, 40: 513-519.
14. Giami, S.T. and D.A. Bekebain, 1992. Proximate composition and functional properties of Raw and process full fat fluted pumpkin (Telfairia Occidentalis) seed flour. J. Sci. Food. Agric., 59: 321-325.
15. Ikenebornah, M.I., R. Kok and J.M. Ingram, 1986. Processing and fermentation of the African locust bean (ParIcla Felocoidea). Can. I. Food Sci. Technol. T., 17: 48-80.
16. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Jood, S., M.B. Chauhan and C.A. Kapoor, 1987. Poly phenols of chickpea and black gram as affected by domestic processing and cooking methods. J. Sci. Food Agric., 39: 145-149.
17. Kachare, D. P., Chavan, J. K. and Kadam, S. S., Nutritional quality of some controlled cow pea, Plants foods for human nutrition, 1994; 38(2): 155-162.
18. Khetarpaul, N. and B.M. Chauhan, 1991. Effect of natural fermentation on phytate and polyphenolic content and in vitro digestibility of starch and protein of pearl millet (P. typhodeum). 3. Sci., 57: 994-997.

19. Klopfenstein, C.F. and R.C. Hoseney, 1995. Nutritional Properties of Sorghum and the Millets. In: D.A.V. Dendy (Ed.), Sorghum and Millets: Chemistry and Technology, American Association of Cereal Chemists Inc, St. Paul, pp: 125-168.
20. Makker, A.O.S. and A.O. Goodchild, 1996. Quantification of tannins. A Laboratory Manual. Internal Centre for Agricultural Research in Dry Areas (ICARDA) Aleppo, Syria IV-25.
21. Malik, M., U. Singh and S. Dahiya, 2002. Nutrient Composition of pearl millet as influenced by genotypes and cooking methods. 3. Food Sci. Technol., 39: 463-468.
22. Mauron, 3., 1982. Effect of Processing on Nutritive Value of Food Protein In: Rechagl, M. (Ed.), Handbook of Nutritive Value of Processed Foods, Vol. 1. CRC Press, Boca Raton, Florida, pp: 429-471.
23. Narayana, K. and M.S. Narasinga Rao, 1984. Effect of partial proteolysisi on the functional properties of winged bean (Phosphorcapus tetragonolobus) flour. 3. Food Sci., 47: 1534-1536.
24. NRC (National Research Council), 1989. Recommended Dietary Allowance. 10th Edn. National Academy Press. Washington D.C.
25. Properties of Millet Grains and Hulls. J. Agric. Food Chem., 2011; 59: 9563–9571.

WEBLIOGRAPHY

- http://organicdimensiondivinemillets.weebly.com/pearl-millet
- http://www.foodofy.com/pearl-millet
- http://www.icrisat.org/PearlMillet/Taxonomy/pmillet
- http://www.nutrichoice4u.com/health-benefits-of-bajra-pearl-millet/
- http://www.swaraj.org/shikshantar/millets-Millets is store-houses of nutrition.
- https://en.wikipedia.org/wiki/Millet