# STANDARDISATION, FORMULATION AND EVALUATION OF NUTRITIOUS PORRIDGE MIX FOR ELDERLY

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## ABSTRACT

The present study aimed to formulate, standardise and evaluate a supplementary nutritious porridge mix prepared from locally available less expensive cereals, pulse, pumpkin seeds and skimmed milk powder for the elderly. Cereals are excellent sources of complex carbohydrates and dietary fibre and reduce lifestyle disorders and diseases in the elderly. The combination of cereals and pulses are complementary in their nutritive quality, more over pumpkin seeds are packed with antioxidants, zinc, and healthy fats, and boost the immune systems of the elderly. Bajra, green gram and skimmed milk powder are rich in protein, and calcium which are vital for maintaining bone health and preventing osteoporosis in the elderly. Selected ingredients are also rich in leucine a branched-chain amino acid needed to maintain muscle mass in the elderly. The supplement was analysed for acceptability, nutrient content, and microbial content. Three variations namely variation I, variation II and variation III were developed with different proportions of cereals, pulse, pumpkin seeds, and skimmed milk powder and evaluated as against standard porridge mix. The results showed that the overall acceptability score for variation III was higher than (8.43) the other two variations (V-I 7.43 and V-II 7.14 ) and the standard recipe. Hence variation III was selected for further analyses (and abbreviated NPM). Mean values obtained for carbohydrate, protein, fat, iron, calcium,fibre and leucine content were 77.63, 18.00, 6.73, 6.60, 388.33, 2.26 and 1.27 respectively in standard recipe and 100.50, 22.53, 7.96, 6.27, 435.33, 4.10 , 2.96 g/100 g respectively in NPM. No microbial growth was observed on $1^{st}$, $30^{th}$, $60^{th}$ and $90^{th}$ day and the total plate count was $12x10^{1}$ CFU/g on the $90^{th}$ day.

The formulated nutritious porridge mix (NPM) was thus most acceptable, providing nutrients most needed for the elderly and could be easily consumed. It could be used as a supplementary food in the regular diet of elderly, to enhance their nutritious status and health.

**Keywords**: Formulation, Microbial analysis, Nutrient composition, Processing, standardisation, Sensory evaluation and Supplementary food.

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## INTRODUCTION

By 2030, "The worldwide demographic of individuals 60 and above is forecasted to rise to 70 million. “The aging population is expected to grow significantly, with those aged 65 and above reaching 88.5 million by 2050. (Chernoff, 2016). These trends explain that the aging population has increased susceptibility to impairment and morbidity. "Aging is associated with notable physiological changes in the digestive system, such as diminished capacities for chewing, swallowing, and digestion, primarily due to dental issues and alterations in gastrointestinal secretions and functionality making chewing and swallowing food more difficult (Leslie and Hankey, 2015; Gallego *et al*., 2022). Problems with chewing and swallowing may decrease caloric consumption, contributing to frailty and making the body more vulnerable to functional impairments." (Clegg and Williams, 2018; Lammes *et al*., 2012). Studies have shown a link between dependency in daily functioning and sub-optimal nutritional well-being (Jain et al., 2021). Engaging in daily activities during older age is crucial as they serve as indicators of the individual's health status (Aguiar et al., 2019).

Therefore, convenience food can serve as an effective method of enhancing the nutritional intake of elderly groups, although it is important to note that not all convenience foods contain sufficient nutrients. Dietary protein is crucial for maintaining physical movement and is related to a decreased risk of hip crack and bone mass density loss (Mustafa et al,2018)
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"Leucine-fortified protein supplementation over 12 weeks effectively improved lean body mass and limb muscularity in sarcopenic elderly populations. “Functional performance of institutionalized elderly was improved when, 6 g/day of leucine was administered (Bauer *et al*, 2015, Martínez- Arnau *et al.*, 2020). "Specialized food formulations for the elderly are essential to support their health and compensate for age-related changes in digestion and nutrient absorption." as they must deliver ample energy and nutrients to fulfill maintenance requirements. Moreover, these products should be presented in formats that ease consumption.

"Bajra, rich in complex carbohydrates, is an invaluable source of sustained energy.", protein, vitamins and minerals. It contains approximately 9 to 13 percent protein making it a good plant-based protein option (Gopalan *et al*., 2014). The protein-rich green gram, with 20% to 31% protein and essential amino acids like leucine and lysine, shares a nutritional profile similar to soy, known for its 18% to 22% protein content."protein, and aligns with the FAO/WHO reference values established in 1973. ( Xu et al., 2015,Yi-Shen et al., 2018)

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According to Zema *et al* (2015), incorporating pumpkin seed flour into supplementary mixes enhances the nutritional profile and is cost-effective. The favorable sensory acceptability properties address both dietary requirements and taste preferences. Porridge is a main food in several countries, mainly in growing ones. It is valued for its ease of preparation and digestibility making it a convenient choice for the elderly and convalescent (Rhim *et al.,* 2011). There are limited food products specifically tailored for the elderly available in the market.

Therefore, with the above insights, the objectives of this research were to develop a nutritious supplementary protein-enriched porridge mix for the elderly from locally available ingredients and to evaluate the sensory acceptability, microbial load, and nutritive value.

## 2.MATERIALS AND METHODS

The present study entitled “Standardisation formulation and quality evaluation of Nutritious Porridge Mix for elderly” (NPM) was carried out as given under the following heads:

1.Procurement and Processing of raw materials
2.Standardization and formulation of NPM
3.Sensory evaluation of NPM
4.Nutrient Analysis of NPM
5.Microbial Analysis of NPM

### 2.1. Procurement and Processing of Raw Materials

"All required ingredients wheat, bajra, green gram, rice flakes, pumpkin seeds, and skimmed milk powder were obtained from the Coimbatore local market". "The combination of cereals and legumes offers a superior nutritive quality by improving the amino acid balance, leading to high biological value proteins." (Oliveira, *et al 2015*). Hence all the grains selected were thoroughly cleaned to remove dust, dirt, insect/excreta and admixtures of other grains. Further, the ingredients such as wheat, green gram and bajra, rice flakes were washed thoroughly under tap water and shade dried till completely dry. Kim et al. (2022) suggest that germination and roasting are effective grain processing techniques for enhancing the positive aroma and flavor components produced by Maillard reactions. Steeping green gram, wheat, and bajra in water for 18 hours, followed by 24 hours of germination, significantly boosts their digestibility and nutrient bioavailability.". According to Alba*,et al* (2019), dry roasting effectively improves sensory attributes as these methods are simple in processing and enhance palatable, flavor, and digestibility of the nutrients. Hence the germinated ingredients were

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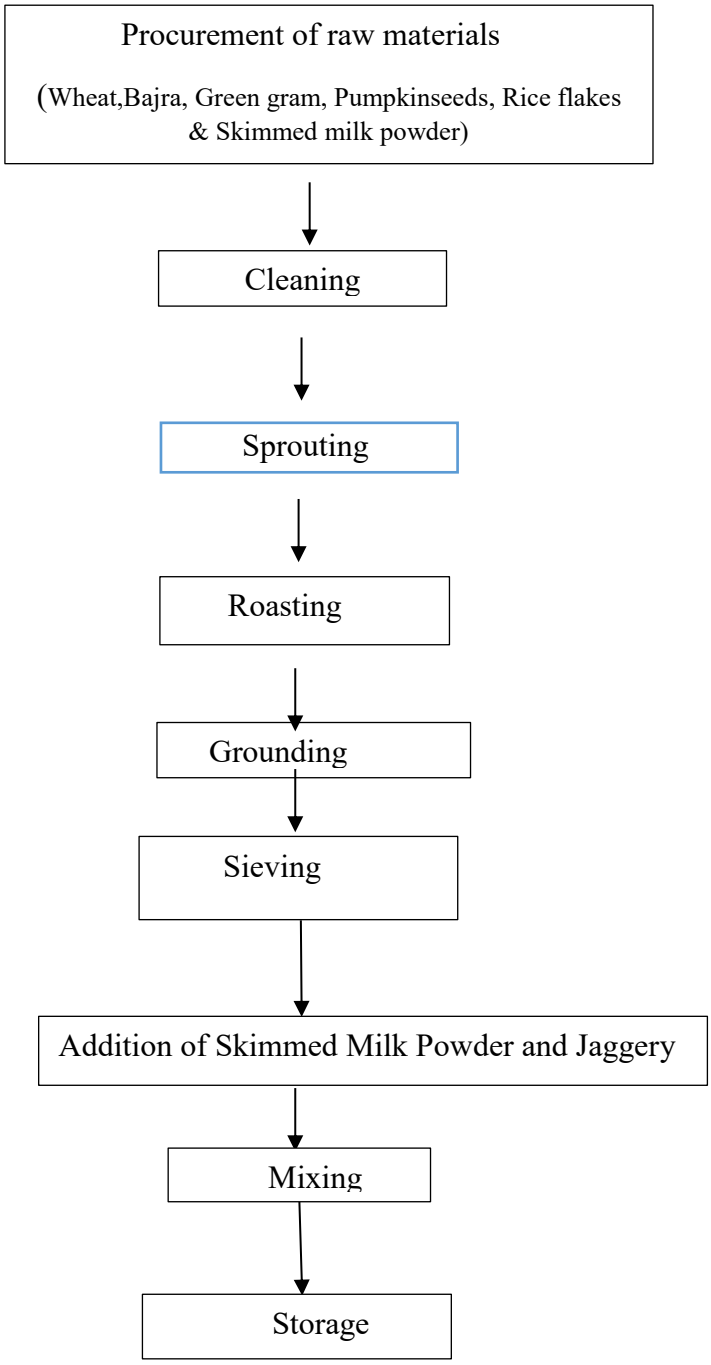
roasted one by one separately at 70-80°C for five minutes until a pleasant aroma was obtained and kept aside for cooling. These methods are simple to perform and improve taste, flavour and digestibility of the nutrients. The roasted ingredients were ground in electric mixer separately to a fine flour one by one and sieved by 80-100 mesh sieves and finally skimmed milk powder was added and thorough mixing was done to obtain a porridge mix. The porridge mix was kept in an air tight container till further analysis.

The preparation of porridge mix is depicted below:




**Flow Chart for Preparation of Nutritious Porridge mix**

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### 2.2. Standardization and formulation of NPM

According to the Bureau of Indian Standards (BIS, 2006), the formulated complete foods should contain not less than 75% of cereals and legumes. A Porridge mix formulated with wheat flour with pumpkin seeds, rice flakes powder and skimmed milk powder was standardised as control. Three formulations namely variation I, variation II, and variation III were developed containing different propositions of wheat flour, bajra flour and green gram flour as the major ingredients. Other ingredients used were rice flakes, pumpkin seeds and skimmed milk powder.

### 2. 3. Sensory Evaluation of NPM

The nutritious porridge was prepared from the formulated powder mix and evaluated for its sensory attributes. The nutritious porridge mixes developed at different variations were made into porridge by adding 450ml of water to 100g of porridge mix followed by cooking in a medium flame for 10 minutes to adequately thick consistency and served hot to semi trained panellists within 10 minutes of preparation. Twenty panellists comprising of members age ranging from 50 years to 60 years were asked to evaluate the porridge for the following sensory attributes on a 9-point Hedonic scale for appearance, colour, texture, taste and overall acceptability as described by Meilgaard, Civille, and Carr (1999). They were asked to test the sensory attributes of the samples individually using score card. Based on the sensory score most acceptable porridge mix was subjected to further nutrient analysis.

### 2.4. Nutrient Analysis of NPM

Selected macro and micro nutrients in NPM were analysed (in triplicates) using standard AOAC (2018) procedures.

### 2.5. Microbial Analysis of NPM

"Monitoring of the samples for aerobic microorganisms, including yeast and mold, was conducted over three months. Total aerobic microorganisms were quantified using Plate Count Agar (PCA) from Himedia, Mumbai, India, by enumerating colonies. Yeast and mold counts were evaluated using Potato Dextrose Agar (PDA) with 0.01% chloramphenicol from the same supplier. Counts are expressed as CFU per gram (CFU/g)."

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## 3.RESULTS AND DISCUSSION

The formulated porridge was assessed for sensory qualities and findings are given in Table I.

### 3.1. Sensory Evaluation of Formulated Nutritious Porridge

**Table I – Mean Sensory Scores of Nutritious Porridge Mix**

| Sensory attributes | Porridge V-I | Porridge V-II | Porridge V-III | f-value | .sig |
|---|---|---|---|---|---|
| Appearance | 7.45±0.82 | 7.45±0.82 | 8.35±0.81 | 8.930 | .000** |
| Colour | 8.15±0.60 | 7.6±0.81 | 8.39±0.59 | 8.060 | .001** |
| Flavour | 7.32±0.65 | 7.6±0.59 | 8.42±0.59 | 18.562 | .000** |
| Texture | 7.40±0.82 | 7.45±0.82 | 8.1±0.44 | 10.376 | .000** |
| Taste | 8.78±0.41 | 7.325±0.65 | 8.78±0.41 | 21.745 | .000** |
| Overall Acceptability | 7.43±0.60 | 7.145±0.73 | 8.43±0.37 | 26.219 | .000** |

****=Significant at 1% level, *=Significant at 5% level**

"Data in Table I indicates that Variation III received the highest overall acceptability score (8.43), surpassing the other two variations and the standard. “The porridge variation II scored the lowest score (7.15) for overall acceptance. The overall acceptance of the formulated porridge mixes depends on the ingredient variations. Overall goodness score of nutritious porridge mix I was 7.43. The results indicate a substantial correlation between sensory evaluation factors such as Appearance, Flavour, Texture, Taste, and Overall Acceptability of Porridge I, II, and III at a statistically significant level of 1%

Colour and appearance serve as influential parameters for the acceptance of food samples. The highest score for colour of variation III porridge mix was obtained as 8.39. Variation II porridge mix received the lowest color score, which was 7.6

"No notable variation was observed in terms of color among the formulated porridge mixes.". Rana *et al* (2015) observed similar results. Variation III obtained the highest score, 8.1 for texture. The other two variations got 7.4 and 7.45 respectively for texture. The scores

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for taste of formulated porridge mixes range from 7.32 to 8.78. Flavour is the one of the essential parameters in sensory assessment. Variation III with highest proportion of green gram scored highest score for flavour as 8.42. Variation II scored 7.6 par with variation I formulation for flavor. The overall acceptability score of variation III was superior (8.43) than the other two variations and standard.

### 3.2. Nutrient Content in NPM

A prevalent observation among elderly groups is the deficiency of both macro and micronutrients (Chernoff, 2016). Thus, a well-designed diet must provide sufficient macronutrients and energy.

The porridge mix with higher scores for overall acceptability was subjected to nutrient analysis with standard procedures. The nutrient values analysed were energy, protein, fat, leucine, fibre, calcium, zinc, iron, ash and moisture content as depicted in Table II.

**Table II Nutrient Content of the Nutritious Porridge Mix - Standard and Variation III**

| Nutrients | Standard | Variation III | 't' value | Critical value | Significance |
|---|---|---|---|---|---|
| Carbohydrate | 77.63±.35 | 100.50±.50 | 64.821 | 5.841 | ** |
| Protein | 18.00±1.00 | 22.53±.21 | 7.687 | 5.841 | ** |
| Fat | 6.73±.31 | 7.96±.02 | 6.920 | 5.841 | ** |
| Fibre | 2.26±.02 | 4.10±.10 | 31.447 | 5.841 | ** |
| Iron | 6.60±.10 | 6.27±.31 | 1.796 | 5.841 | NS |
| Calcium | 388.33±.58 | 435.33±2.52 | 31.529 | 5.841 | ** |
| Leucine | 1.27±.22 | 2.96±.02 | 13.310 | 5.841 | ** |
| Zinc | 2.86±.21 | 2.97±.06 | 0.840 | 5.841 | NS |
| Moisture | 5.67±.58 | 3.00±.00 | 8.000 | 5.841 | ** |
| Ash | 4.00±.00 | 3.23±.15 | 8.693 | 5.841 | ** |
| Energy | 391.00±1.00 | 436.33±1.53 | 43.007 | 5.841 | ** |

** - Significant at 1% level NS – Not significant

The data of standard mix was compared with NPM V- III. Mean values observed for Carbohydrate, Protein, Fat, Iron, Calcium and Leucine were 77.63, 18.00, 6.73, 6.60, 388.33, 1.27, in Standard recipe and 100.50, 22.53, 7.96, 6.27, 435.33, 2.96 g/100 g respectively in developed nutritious porridge mix variation III. Protein content of NPM prepared using 50g of green gram, bajra 20g was found to be high (22.3g) than the standard sample protein

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content (19g). The higher protein in NPM can be attributed to the inclusion of green gram and bajra, which are recognized for their rich protein composition. The addition of 50g of green gram resulted in a notable increase in protein content.

The carbohydrate, protein, calcium, ash and energy content of Variation III and standard were observed to be significantly different at 1% level. The calcium content was found to be 433mg in NPM which is higher than the standard recipe ($p<0.01$). There was no notable difference in iron and zinc composition of both mixes. It was noted that the moisture content of NPM was 3%. The moisture content of flour is a key quality indicator, playing a vital role in determining the storage stability, and consumable quality of food products (Ibeabuchi *et al,* 2017; Gemede, 2020).

**3.3 Microbial Analysis of NPM**

No microbial growth was detected on the 1st, 30th, and 60th days. However, by the 90th day, the total plate count reached $12 \times 10^1$ CFU/g.

**Table III Microbial Analysis of NPM**

| S.no | Parameter | Intervals(days) | | | |
|---|---|---|---|---|---|
| | | 1st Day | 30th Day | 60th Day | 90th Day |
| 1. | Total plate count | - | - | - | $12x10^1$ CFU/g. |
| 2. | Coliform | - | - | - | - |
| 3. | Yeast & mould | - | - | - | - |

Coliform bacteria, yeast and mould were not detected in the formulated porridge mix with variation II throughout the storage period of 90 days. Shelf-life assessment is vital for furnishing the information about significant time period for safe consumption of a food product, The total viable count detected in the present study for nutritious porridge mix, over a period of three months, was found to be within permissible limit (FSSAI, 2012; ICMSF, 2014).

**Conclusion**

Value addition of cereals and pulse combination are more convenient and sustainable cost-effective strategy to address the macro and micro nutrient malnutrition in all age groups particularly in old age. Three different energy and protein -rich porridge formulations have

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been developed in the present study. Variation III was found to have superior sensory attributes, including colour, texture, flavour, and general acceptance. Moreover, the formulated NPM was high in nutrient content i.e protein (22.3g) energy (436Kcal) calcium (433 mg) iron (6mg) leucine (2.95g) and carbohydrate (100.5g) as compared to standard mix i.e protein (19.0g ) energy (391Kcal) calcium (388.4mg) leucine (1.02g) and carbohydrate (77.3g) probably due to the presence of bajra and green gram in NPM. It can be concluded that that the good nutrient content of developed NPM with acceptable sensory attributes recommends it to be used as a supplementary food in the regular diet of elderly.

**References**


- Bauer, J.M.; Verlaan, S.; Bautmans, I.; Brandt, K.; Donini, L.M.; Maggio, M.; McMurdo, M.E.; Mets, T.; Seal, C.; Wijers, S.L. Effects of a vitamin D and leucine-enriched whey protein nutritional supplement on measures of sarcopenia in older adults, the PROVIDE study: A randomized, double-blind, placebo-controlled trial. J. Am. Med. Dir. Assoc. 2015, 16, 740–747. [CrossRef] 10
- Chernoff, R., 2016. Elderly: nutrition requirements. In: Caballero, B., Finglas, P.M. and Toldra, F. (eds.) Encyclopedia of food and health. Academic Press, Cambridge, MA, pp. 480–486.
- Clegg, M.E. and Williams, E.A., 2018. Optimizing nutrition in older people. Maturitas 112: 34–38. https://doi.org/10.1016/j. maturitas.2018.04.001
- Deutz N.E.P., Bauer J.M., Barazzoni R., Biolo G., Boirie Y., Bosy-Westphal A., Cederholm T., Cruz-Jentoft A. Protein intake and exercise for optimal muscle function with ageing: Recommendations from the ESPEN Expert Group. *Clin. Nutr.* 2014; 33:929–936. doi: 10.1016/j.clnu.2014.04.007. [PMC free article] [PubMed] [Cross Ref] [Google Scholar]
- Eggum, B. and Beames, R. (1983). The nutritive value of seed proteins. In: "Seed Proteins".). pp. 499-531. Springer.
- Gemede, H. F. (2020). Nutritional and antinutritional evaluation of complementary foods formulated from maize, pea, and anchote flours. *Food Science & Nutrition*, 8(4), 2156–2164. [PMC free article] [PubMed] [Google Scholar]
- Ghavidel RA , Ghasemzadeh R,. Processing and assessment of quality characteristic of cereals - legumes composite weaning foods. International Conference on Bioscience, Biochemistry and Bioinformatics (IPCBEE), IACSIT Press, Singapore, 2011; 5
- Gallego, M., Barat, J.M., Grau, R. and Talens, P., 2022. Compositional, structural design and nutritional aspects of texture-modified foods for the elderly. Trends in Food Science and Technology. 119: 152–163. https://doi.org/10.1016/j.tifs.2021.12.008
- Ibeabuchi, J. C. , Okafor, D. C. , & Peter-Ikechukwu, A. , Agunwa, I. M. , Eluchie, C. N. , Ofoedu, C. E. , & Nwatu, N. P. (2017). Comparative Study on the Proximate Composition, Functional and Sensory Properties of Three Varieties of Beans Phaseolus lunatus, Phaseolus vulgaris and Vigna um–bellata . International Journal of Advancement in Engineering Technology, Management and Applied Science (IJAETMAS), 5(1), 1–23. [Google Scholar]
- M. Jain, P. Jain, A. Kumari, N. Jain, An exploration of nutritional status in relation to diet quality, functional and mental ability among elderly in Tonk, India, Malaysian Journal of Medicine and Health Sciences, 17 (3) (2021), pp. 232-

- Lammes, E., Rydwik, E. and Akner, G., 2012. Effects of nutritional intervention and physical training on energy intake, resting metabolic rate and body composition in frail elderly. A randomized, controlled pilot study. Journal of Nutrition, Health and Aging. 16(2): 162–167. https://doi.org/10.1007/s12603-011-0157-7
- Martínez-Arnau, F.M.; Fonfría-Vivas, R.; Buigues, C.; Castillo, Y.; Molina, P.; Hoogland, A.J.; van Doesburg, F.; Pruimboom, L.; Fernández-Garrido, J.; Cauli, O. Effects of leucine administration in sarcopenia: A randomized and placebo-controlled clinical trial. Nutrient 2020, 12, 932. [CrossRef]
- Meilgaard, M.; Civille, G.V. and Carr, B.T. (1999). Sensory evaluation techniques. Boca Raton: CRC Press. 4th ed. CRC Press, New York, NY.
- Mustafa, J., Ellam, N., Hemsley, C., & Ireland, A. (2018). Dietary protein and muscle health: Beyond the simple question of how much and how often. *Journal of Nutrition and Metabolism*, 2018, Article ID 2654981. https://doi.org/10.1155/2018/2654981
- Oliveira, C.T., Gutierrez, é. M. R., Márcio, C., Monteiro, M.R.P., Labanca, R.A. and Carreira, R.L. (2015) Development and Characterization of Extruded Broken Rice and Lupine (Lupinus albus). American Journal of Plant Sciences, 6, 1928-1936. http://dx.doi.org/10.4236/ajps.2015.612194 [Citation Time(s):1]
- Rhim, J.-W., Koh, S. and Kim, J.-M. (2011). Effect of freezing temperature on rehydration and water vapor adsorption characteristics of freeze-dried rice porridge. J. Food Engineering. 104 (4), 484-491.
- Soini, H., Suominen, M. H., Muurinen, S., Strandberg, T. E., & Pitkälä, K. H. (2011). Malnutrition according to the mini nutritional assessment in older adults in different settings. Journal of the American Geriatrics Society, 59, 765-766. doi:10.1111/ j.1532-5415.2011. 03339.x
- Srilakshmi, B, (2007) Food science, 4th Ed. New age international (P) Ltd. New Delhi. 170-174.
- Tabloski, P. A. (2014). Gerontological nursing. New York, NY, USA: Pearson.
- Vanesa Castro-Alba, *et al* Effect of fermentation and dry roasting on the nutritional quality and sensory attributes of quinoa, Food Sci Nutr. 2019 Dec; 7(12): 3902–3911.Published online 2019 Nov 6. doi: 10.1002/fsn3.1247
- World Health Organization (2002a) Active Ageing: A Policy Framework., Available via http://www.who.int/ageing/publications/activeageing/en/index.html. Accessed 22 Aug 2010
- Xu X.P., Liu H., Tian L.H., Dong X.B., Shen S.H., Qu L.Q. Integrated and comparative proteomics of high-oil and high-protein soybean seeds. *Food Chem.* 2015; 172:105–116. doi: 10.1016/j.foodchem.2014.09.035. [PubMed] [Cross Ref] [Google Scholar]
- Zema, T.; Bosha, T. and Belachew, T. (2015). Blending Germinated Maize, Pumpkin Pulp and Its Seed Improves Zinc and Vitamin a without Compromising Nutritive Value and Sensory Attributes of Local Complementary Food Porridge. Food and Public Health, 5(4): 103-106