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RESEARCH ARTICLE

Chemical composition of organically produced variety of *Kulath* (*Macrotyloma uniflorum*) and incorporation into commonly consumed legume based recipes

■ **Priyanka Joshi and Arti Sankhala**

SUMMARY

Horse gram (*Macrotyloma uniflorum*) also known as *Kulath* in Hindi, is one of the lesser known beans of India.The whole seeds of *Kulath* are generally utilized as sprouts, or as whole meal particularly in southern Indian states. The chemical composition is comparable with more commonly cultivated legumes. The present investigation was an attempt to analyze proximate and mineral composition and antioxidant property of *Kulath.* Commonly consumed legume based recipes *viz.,* soup, cutlets, *Cheela*, *Khichdi* and *Sev* were also prepared with previously processed *Kulath*. Results revealed that 100 g *Kulath* contained 22.4 g crude protein, 0.7 g crude fat, 3.4 g total ash, 4.8 g crude fibre, 59.4 g carbohydrates, 334 kcal energy, 173.22 mg calcium, 153.08 mg magnesium, 4.76 mg iron and 4.49 mg zinc, respectively. Protein digestibility *in-vitro* of *Kulath* was found to be 59.3 % whereas iron bioavailability was observed to be 0.18 mg/ 100g that pertaining to 3.8 % availability of iron in the body. Anti-nutritional factors *i.e.* tannin and phytate content of *Kulath* was found to be 0.33% and 1.3%, respectively and had a good antioxidant property (53.5%). Acceptability of recipes was assessed on 9 point hedonic scale by a group of 10 panel members. Mean scores for overall acceptability varied from 7.9 to 8.5 indicating that recipes were highly acceptable by the panel members. It can be concluded that organically produced variety of *Kulath* were found to contain all essential nutrients and thus, can be recommended for daily household consumption to contribute various nutrients.

Key Words : *Kulath*, Chemical composition, Antioxidant property, Value added products, Sensory evaluation

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MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
Priyanka Joshi, Department of Food Science and Nutrition, College of Community and Applied Sciences, Maharana Pratap University of Agriculture and Technology, **Udaipur (Rajasthan) India**
Email : priyanka_fn@yahoo.co.in

Address of the Co-authors:
Arti Sankhala, Department of Food Science and Nutrition, College of Community and Applied Sciences, Maharana Pratap University of Agriculture and Technology, **Udaipur (Rajasthan) India**

Horse gram (*Macrotyloma uniflorum*) belongs to family *Fabaceae,* is one of the important minor pulses grown in India, Burma, Shrilanka and Australia. Horse gram provides nutritious fodder for animals in addition to grain and refers as dual purpose crop. In India, it is known by many names such as kulith, *Kulath*, kulthi gahat, depending on state or region where it is produced/ consumed. Horse gram is legume of the tropics and subtropics, grown mostly under dry-land

agriculture. Horse gram has been reported to have a lot of medicinal value. The rich fibre content of horse gram helps in reducing the body fat in fast mode. It is believed that eating horse gram makes our body strong and is also good in treating stones, menstrual problems, obesity, curing cough and cold (Ishwarya and Swamalatha, 2020).

The chemical composition is comparable with more commonly cultivated legumes. Like other legumes, these are deficient in methionine and tryptophan, though horse gram is an excellent source of iron and molybdenum. The crude fibre, calcium and iron content of horse gram are higher than the red gram which is largely consumed by majority of the Indian population. Comparatively, horse gram seeds are reported to have higher amounts of tannins, phytic acid content, trypsin inhibitor and hemagglutinin activities and natural phenols than most bean seeds. Dehusking, soaking, germination, cooking, and roasting have been reported to produce beneficial effects on nutritional quality of the legumes.

Keeping the above facts in mind, there is a greater need to incorporate this nutritional rich *Kulath* in traditional and commonly consumed legume based recipes in daily diet and the information on the nutritional quality, anti-nutritional factors and antioxidant profile of *Kulath* is rather also scarce. Hence, the present investigation was designed to evaluate the chemical composition of organically produced variety of *Kulath*. Commonly consumed legume based recipes were also prepared with previously processed *Kulath* for achieving food and nutrition security.

MATERIAL AND METHODS

Sample collection:

Organically produced variety of *Kulath* was procured from an organic store "Banyan roots" of Udaipur city, Rajasthan. The sample was cleaned well to make them free from dust and grit, weighed and packed in poly bags.

Proximate analysis:

Kulath was ground using electronic food grinder before analysis. Proximate values, *i.e.* moisture, crude protein, crude fat total ash and crude ber were determined by Official Analysis Methods of the AOAC (2000).

Mineral composition:

Mineral solutions of samples were prepared by wet ash method. The digested samples were analyzed by standard procedures *i.e.* calcium, iron and zinc were estimated using atomic absorption spectrometer (Bishnoi and Brar, 1988). The values are measured in ppm.

Protein digestibility *in-vitro*:

Dry sample of *Kulath* was analysed by the method of Mertz *et al*. (1984 using following formula :

Protein digestibility=Digested protein/Total protein X 100

Iron bioavailability *in-vitro*:

Iron bioavailability *in- vitro* determination of *Kulath* samples was done by using standard method of Lock and Bender (1980).

Anti-nutritional factors:

Anti-nutritional factors such as total tannin and phytic acid content were estimated using the method of Ataassova and Christova (2009) and Peach and Fracy, 1955, respectively.

Antioxidant activity analysis:

The concentration of total phenolic content in *Kulath* was determined by the method of Mc Donald *et al.* (2001) and DPPH activity was analyzed by the standard procedure (McCune and Johns, 2002).

Value addition and product formulation:

Selection of recipes:

Popular legume based commonly consumed recipes were selected wherein legumes were replaced by underutilized pulses, respectively. Various recipes like soup, cutlet, *Cheela*, *Kichadi* and *Sev* were prepared using *Kulath*.

Processing of raw materials:

Kulath contains anti-nutritional factors such as trypsin inhibitors, tannins and phytates which have to be reduced prior to human consumption. Various processing treatment including soaking, germination, autoclaving and roasting were used to reduce their content. Out of these treatments, soaking and roasting were used in present investigation before product development.

Standardization and preparation of recipes:

Selected recipes were standardized for their ingredients, amounts and method of preparation. Soup, cutlet, *Cheela* and *Khichdi* were prepared by soaked *Kulath* seeds whereas, roasted *Kulath* flour was used for *Sev* preparation. The products developed were initially

assessed for their acceptability by the investigator and her colleagues working in the laboratory and modified.

Sensory evaluation of developed products:

The sensory qualities such as appearance, colour, texture, taste, flavour and overall acceptability were evaluated by a panel of 10 judges for their acceptability using 9 point Hedonic scale.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Proximate analysis:

The chemical composition provides basic information about the components and quality of the products. Hence, proximate and mineral composition (Ca, Mg, Fe and Zn) were analyzed and discussed to evaluate the nutritional quality of the organically produced variety of *Kulath*. The results presented in the Table 1 indicate that the moisture content of *Kulath* was discerned to be 9.3 g/100g which was relatively higher than the values reported by Jogyabathi *et al.* (2001) and Gopalan *et al.* (2007), who found that moisture content of *Kulath* ranged between 10.52- 11.8 g/100g. The crude protein of *Kulath* was recorded to be 22.4 g/100g (Table 1). This value is similar to the value (22.0 g/100g) given in food composition tables (Gopalan *et al*., 2007). However, Moktan and Ojha (2016) found slightly lower amounts of crude protein content *i.e.* 20.9 g/100g in *Kulath* flour (non-germinated). The protein content of *Kulath* is comparable to those of other edible leguminous seed flours, such as chickpea, pigeonpea, some varieties of cowpea and soyabean (Olaofe *et al*., 1994). The crude fat content of *Kulath i.e.* 0.7 g/100g was similar with the findings of Moktan and Ojha (2016) and Gopalan *et al.* (2007), who found that crude fat content of *Kulath* flour was 0.8 g/100g and 0.5 g/100g.

Table 1: Chemical Composition of organically produce variety of *Kulath*

Nutritional parameters	(Mean + SD)
Moisture (g)	9.3 ± 0.48
Fat (g)	0.7 + 0.25
Protein (g)	22.4 + 1.19
Carbohydrate (g)	59.4 ± 1.21
Ash (g)	3.4 ± 0.14
Fibre (g)	4.8 ± 0.57
Energy (kcal)	334 + 2.78
Calcium (mg)	173.22 + 1.85
Magnesium (mg)	153.08 + 3.2
Iron (mg)	4.76 ± 0.7
Zinc (mg)	4.49 ± 0.9
Protein digestibility *in- vitro* (%)	59.3 + 2.9
Iron bioavailability *In-vitro* (mg/100 g)	0.18 + 0.02
Per cent availability of iron	3.8 + 0.6
Tannin (g/100g)	0.33 ± 0.03
Phytate (g/100g)	1.3 ± 0.05
Total phenolic content (mg of CE/g)	0.93 ± 0.07
DPPH radical scavenging (%)	53.5 + 1.35

The ash content is inorganic residue remaining after the removal of water and organic matter by heating in the presence of the total amount of minerals in a food. The ash content of *Kulath* was found to be 3.4 g/100g (Table 1) which was more or less similar (3.8 -3.2 g/ 100g) to studies conducted earlier (Moktan and Ojha, 2016 and Gopalan *et al*., 2007). The data presented in the Table 1 clearly depicts the crude fibre content of *Kulath* was 4.8 g per 100g. The results are in concurrence with those reported by Gopalan *et al*. (2007) and Moktan and Ojha (2016) for *Kulath* flour. The high fibre content of *Kulath* might be helpful in terms of maintaining positive effects on intestine and colon physiology, besides other homoeostatic and therapeutic functions in human nutrition.

The carbohydrate content as calculated by difference method. The data showed that *Kulath* contained 59.4% of carbohydrates which was differed from the earlier studies. The only attributable factor for this difference is the differences in other constituents like moisture, fats, ash, fibre and protein of the samples. It is apparent from the data given in Table 1, the energy value of *Kulath* was observed to be 334 kcal per 100g, respectively. The composition of nutrients in food can vary considerably between regions within a country as well as between countries. Such differences can be caused by variation in temperature, rainfall and access to water, use of fertilizer, nutrient content of the soil, etc. (Greenfield and Southgate, 1992).

Mineral composition:

Minerals are inorganic substances present in all living and non-living things including man, animals, rocks and soil. Their presence in living things is necessary for the maintenance of certain physiological processes (Hays and Swenson, 1985 and Ozcan, 2003). The data

presented in the Table 1 showed that *Kulath* contained 173.22 mg, 153.08 mg, 4.76 mg and 4.49 mg of calcium, magnesium, iron and zinc, respectively. When compared with the findings of studies conducted earlier (Gopalan *et al*., 2007 and Moktan and Ojha, 2016) the present observations were higher, lower or comparable with the respective counter parts. The variation in mineral content in present and reported studies may be due to difference in variety, soil and water composition of places where the food is grown.

Protein digestibility *in vitro*:

Nutrient digestibility or bioavailability largely determines the nutritional profile of any food. To study the efficacy of any processing method, it is important to observe the effect it exerts on the digestibility of nutrient. The protein digestibility of *Kulath* was found to be 59.3%.

Iron bioavailability *in vitro*:

Iron bioavailability is the measure of the proportion of the total iron in a food or diet that is digested, absorbed and metabolized (Fairweather-Tait, 1987). Bioavailability of iron from food systems is an outcome of its interaction of its components. Phytic acid content of foods retains minerals in the intestinal lumen by forming insoluble complexes and reduces the bioavailability of minerals such as iron, zinc, calcium and copper. As can be seen from the Table 1, iron bioavailability *in-vitro* of *Kulath* was 0.18 mg/100g and per cent availability of iron was (3.8%).

Antioxidant activity :

Total phenol content :

The total phenol content, in the examined samples of millets, legume and red rice using the Folin Ciocalteu's reagent was expressed in terms of catechol equivalent. The values obtained for the concentration of total phenols are expressed as mg of CE/g of extract. The total phenolic content of *Kulath* was observed to be 0.93 mg of CE/g which was on the higher side than the values reported by Kamath *et al*. (2015) who found that total phenolic content *i.e.* 0.75 mg GAE/g in *Kulath*.

DPPH assay :

The per cent DPPH radical scavenging activity of *Kulath* analyzed and the results showed that DPPH scavenging ability for *Kulath* was 53.5%. These results are in agreement with the findings (56.5%) recorded by Petchiammal and Hopper (2014). In addition, Kamath *et al*. (2015) examined the total antioxidant activity *i.e.* 14.39 mg of AAE/g sample in *Kulath* flour.

Anti nutritional factors :

Data presented in Table 1 depicts the phytic acid and tannin content in *Kulath* was 1.3g/100g and 0.33g/100g, respectively. The results are in line with those reported by Yadahally *et al*. (2012). The amount of phytate in grains, nuts, legumes and seeds is highly variable, the levels that researchers find when they analyze a specific food probably depends on growing conditions, harvesting techniques, processing methods, testing methods and even the age of the food being tested.

Value addition and product development:

In present investigation, soaking and roasting treatments were used before product development. Soup was prepared from soaked and pressure cooked *Kulath* taking it as a base ingredient whereas, cutlet, *Cheela* and *Khichdi* were made by replacing other pulses/legumes. *Sev* was developed from 40% incorporation of roasted *Kulath* flour along with gram flour.

Score for value added food products *i.e.* soup, cutlets, *Cheela*, *Khicadi* and *Sev* prepared from *Kulath* showed that all the products were highly acceptable by the panel members. The overall acceptability score was rated from 7.9 to 8.5 in all the products whereas for taste and texture the scores ranged from 8.2 to 8.6 and 8.0 to 8.3, respectively (Table 2). Several studies conducted earlier have been reported that horse gram powder was incorporated at different levels for preparing

Table 2 : Mean ± SD scores of sensory characteristics of commonly consumed recipes incorporated with *Kulath*

Food products	Colour	Flavour	Taste	Texture/consistency	Appearance	Overall acceptability
Soup	8.0 + 0.63	8.3 + 0.64	8.3 + 0.64	8.1 + 0.52	8.0 + 0.77	8.2 + 0.61
Cutlets	8.4 ± 0.66	8.4 ± 0.66	8.3 ± 0.64	8.3 ± 0.45	8.7 ± 0.46	8.5 ± 0.38
Cheela	8.4 ± 0.80	8.3 ± 0.64	8.3 ±0.64	8.2 ± 0.53	8.4 ± 0.66	8.4 ± 0.57
Khichdi	7.9 ± 0.64	8.0 ± 0.51	8.2 ± 0.64	8.0 ± 0.61	7.8 ± 0.42	7.9 ± 0.64
Sev	8.0 + 0.66	8.4 + 0.66	8.6 + 0.66	8.3 + 0.45	8.3 + 0.45	8.4 + 0.57

various value added products. Ishwarya and Swamalatha, 2020 conducted a study on formulation of value added products *i.e.* cookies and *Adai* using germinated horse gram flour with the replacement of wheat flour and *Ragi* flour. Sensory evaluation results showed that variation I (20% G.H.F.) in cookies and variation II (60% R.H.F.) in *Adai* were found to be superior to other samples.

Instant soup mix was prepared from sprouted horse gram, radish leaves powder, onion powder, garlic powder, coriander powder, curry leaves powder, pepper powder, and salt in different ratios of the ingredients. The prepared product samples were evaluated for sensory evaluation and shelf-life. Result revealed that sample S_2 (sprouted horse gram powder- 25 g and raddish leaves- 12.5 g) got significantly higher values for appearance (4.6), colour (4.1), flavour (4.6) and taste (4.4) on 5 point scale than the other two samples (Sudarsan *et al*., 2017).

Niharika and Verma (2016) formulated two value added products *i.e. Khakra* and *Idli* by using germinated horse gram powder ranging from 5 to 15% incorporation. Mean scores of sensory evaluation of products were found to be ranging from 3.5-4 for *Idli* and 3.8-4.4 for *Khakra* at 5 point scale indicated that both the products were highly acceptable by the panel members upto a level of 10 % incorporation. Bhokre *et al*. (2012) prepared buns fortified with germinated horse gram flour. Results revealed that incorporation upto 15% of germinated horse gram flour in buns was found to be acceptable. In the same line, Thirukkumar and Sindumathi (2014) prepared *Chapatti* incorporated with processed horse gram flour, the results showed that *Chapatti* prepared from wheat flour incorporated upto 15% roasted horse gram was highly acceptable.

Conclusion :

It can be concluded that organically produced variety of *Kulath* was rich in all the essential nutrients *i.e.* crude protein, crude fibre, minerals and antioxidants than the commonly consumed legumes that are extensively available in the market. Moreover, *Kulath* based commonly consumed recipes *viz*., soup, cutlets, *Cheela*, *Khichdi* and *Sev* were found to be acceptable by the panel of judges. Hence, it can be recommended for daily household consumption for achieving food and nutrition security.

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