International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 3425-3427

Received: 01-03-2018
Accepted: 05-04-2018

Kanmani K
Department of Food Science and Nutrition, Community Science College & Research Institute, Tamil Nadu Agricultural University, Madurai District, Tamil Nadu, India

Geetha PS
Department of Differently Abled Studies, Community Science College &Research Institute, Tamil Nadu Agricultural University, Madurai District, Tamil Nadu, India

Uma Maheswari T
Department of Food Science and Nutrition, Community Science College & Research Institute, Tamil Nadu Agricultural University, Madurai District, Tamil Nadu, India

Vijayalakshmi R
Department of Human Development and Family Studies, Community Science College & Research Institute, Tamil Nadu Agricultural University, Madurai District, Tamil Nadu, India

Vanniyarajan C
Department of Plant Breeding and Genetics, Agricultural College & Research Institute, Tamil Nadu Agricultural University, Madurai District, Tamil Nadu, India

Correspondence
Kanmani K
Department of Food Science and Nutrition, Community Science College & Research Institute, Tamil Nadu Agricultural University, Madurai District, Tamil Nadu, India

Proximate analysis of extrudates from horse gram and moth bean

Kanmani K, Geetha PS, Uma Maheswari T, Vijayalakshmi R, Vanniyarajan C

Abstract
Horse gram and moth bean are legumes of the tropics and subtropics, grown mostly under dry-land agriculture. The chemical composition is comparable with more commonly cultivated legumes. Among the underutilized pulses, Horse gram and Moth bean has the major protein source of up to 22-23/100g. Hence, this study was framed to develop value added products so as to increase the consumption of these underutilized pulses and to raise the awareness on health and nutritional benefits of horse gram and moth bean. The extrudate was developed from Horse gram and Moth bean using twin screw extruder with the barrel temperature of 121 ºC. The chemical parameters such as moisture, carbohydrate, fat, fibre, calcium and iron content were analyzed for the raw flour and extruded product. The results showed that moisture, carbohydrate, fat, fibre, calcium and iron content are 9.07%, 70.98g, 2.35g, 16.14g, 126mg, 13mg were significantly increased and the anti-nutritional factors such as phytate were decreased to 7.48 after extrusion process in comparison with raw flour.

Keywords: Horse gram, Moth bean, Extruded product, Chemical Parameters

Introduction
The dependence of humankind on plant resources is inevitable. Underutilized plants constitute the lesser knownspecies in terms of trade and research. Horse gram *(Macrotylomauniflorum)* previously *(Dolichosbiflorus*) is an underutilized and unexplored food legume (Aiyer 1990; Reddy *et al*., 2008) [1 & 14]. It is considered as a good source of protein, carbohydrates, energy (Bravo *et al*. 1998) [6]. Owing to their nutritional and medicinal value, there is an increased demand to explore an underutilized legume to alleviate malnutrition and reduce risk of various diseases (Chelguerrero *et al*. 2002; Arinathan *et al*. 2003) [7 & 4]. Horse gram is an excellent source of protein (17.9– 25.3 %), carbohydrates (51.9–60.9 %), essential amino acids, energy, low content of lipid (0.58–2.06 %), iron (Bravo 1999; Sodani *et al*. 2004) [5 & 18], molybdenum (Bravo 1999) [5], phosphorus, iron and vitamins such as carotene, thiamine, riboflavin, niacin and vitamin C (Sodani *et al*. 2004) [18]. Moth Bean seeds are a good and potential reservoir of proteins and other essential minerals and vitamins. Mothbean is one of the major protein food source. It is rich in protein (23.6 g), calcium (202 mg) in it can make it an excellent supplement to cereal diet. Moth Bean is a cheap source of nutrients and forms a specific and perfect diet. Moth bean is mostly consumed as dhal or sprouts. The whole seeds of horse gram are generally utilized as cattle feed. However it is consumed as a whole seed, sprouts or whole meal by a large population in rural areas of southern India.

Materials and methods
Horse gram and Moth bean were purchased from the local market Madurai, Tamil Nadu. The seeds are thoroughly cleaned and washed to remove broken grain, dust, stones and other foreign materials. Then the seeds are soaked for 6-8 hours and dried it in a cabinet drier for 6-8 hours. The dried pulses weremilled to flourusing pulverizerand it is sieved through BS100 sieve.

Standardization of extrusion conditions
The milledflour was prepared with the feed moisture of 8% and it is kept at room temperature for pre-conditioning of flour for 1-2 hours. After preconditioning, the extrudates were developed using Twin Screw Extruder (FPBIC 16) at Indian Institute of Food processing Technology (IIFPT), Thanjavur, Tamil Nadu after standardization of barrel temperature

to121 °C for all the samples. The obtained extrudates were dried at 30-35 °C for 30-45 min and packed.

Proximate analysis for flour and extrudate

The moisture content of the samples was estimated by hot air oven method as per the procedure given by AOAC (1997) [3]. The protein was analyzed by Micro kjeldhal method (Ma and Zuazaga, 1942) [9].The fat content of the sample was estimated as described by Cohen (1917) [8] using Sox plus apparatus. Crude fiber content was determined as per the method described by Maynard (1976) [11].Total carbohydrate content was determined by anthrone method (Sadhasivam and Manickam, 2008) [17]. The estimation of phytic acid was based on the principle that the phytate is extracted with trichloroacetic acid and precipitated as ferric salt (AOAC, 1997) [3]. The DPPH assay was performed according to procedure described by Nuengchamnong and Ingkaninan (2010) [12]. The calcium, phosphorus and phytate content was analysed by the method as described by Ranganna (1986) [15]. The iron content present in the flour and extrudates were measured by using Ranganna (1986) [15]

Results and discussion

Nutrient and proximate composition of horse gram and moth bean

The proximate analysis was done for both raw flour and extruded products for Horse gram and Moth bean. The parameters are moisture, protein, carbohydrate, fat, fibre, calcium, iron and phytate.

Table 1: Effect of raw and processed chemical parameters for Horse gram and Moth bean

S. No	Parameters	Horse gram		Moth Bean	
		Raw flour	Extruded product	Raw flour	Extruded product
1	Moisture (%)	9.72	9.07	9.28	8.40
2	Carbohydrate (g/100g)	68.70	70.98	57.90	60.20
3	Protein (g)	23.00	21.00	23.50	22.50
4	Fibre (g)	16.07	16.14	3.90	4.20
5	Fat (g)	2.30	2.35	4.20	4.65
6	Calcium (mg/kg)	120.00	126.00	280.00	310.00
7	Iron (mg/kg)	11.00	13.00	9.00	11.00
8	Phytate (mg/kg)	15.00	7.48	0.85	0.76

The table 1shows the effect of parameters before and after extrusion of pulses. There was a slight decrease in moisture content after extrusion and the protein content in the pulses were increased slightly (Table 1). Liu *et al*. (2005) [16] reported that the moisture content range from 38–44%, the tensile strength ratio ranges from 1.45 to 2.01. Omohimi *et al*. (2014) [13] stated that moisture Values between 6.53–11.93 % were observed for the extruded mucuna bean meat analogue samples.Within a range that could prevent microbial activity that enhances spoilage and also ensure shelf stability of the extrudates. Ajita and Jha (2017) [20] observed the product moisture content of starch-PDPF extrudates, after drying at 60 °C for 12 h, was 4.0 -0.5%. The low moisture content would be anticipated to yield products with a high degree of crispness. It can be observed that fibres were formed in a wide range of moisture content.

Sreerama *et al*. (2008) [21] reported that xylanase-treated horse gram expanded dhal had higher protein compared to dehusked raw deal and untreated expanded dhal differing statistically ($P< 0.05$). Degradation of some of the cell wall non-starchy polysaccharides by xylanase may have resulted in a lower carbohydrate and a higher protein content in the enzyme treated grain.

The extrudate fat and fibre content was also increased when compared with raw flour for both horse gram and moth bean. Raw and processed horse gram contains similar content of the total dietary fibre in the range of 14.57–16.14% (Sreerama *et al*., 2008) [21]. For horse gram, the moisture content, total dietary fibre, crude carbohydrate, crude fat, crude protein and are, 6.72 ± 0.02%; 12.14 ± 0.35%; 58.32 ± 0.10%; 1.25 ± 0.15%; 22.12 ± 0.18%; respectively (Marimuthu and Krishnamoorthi 2013) [10]

Abdoulaye *et al.* (2012) [2] stated that protein, fat, fibre, ash andmineral contents were increased with increased level of incorporation of millet and pulse flour. Protein, fat and fibre content of extruded products increased and ranged from 18.20 to 18.37 per cent, 8.76 to 9.26 per cent, 9.72 to 10.98 per cent in millet and soybean extruded products. The increase in mineral composition is possibly due to addition of germinated millet flour and roasted soybean flour.

Conclusion

In spite of nutritive value, the horse gram and moth bean is not properly utilized for the consumption and it is not familiar among peoples. Hence, the extruded product from these pulses could possibly increase the consumption. The extrudate developed from horse gram and moth bean had a similar appearance to the market product. The cooking quality does not meet the quality of control because the extrudate was easily soluble in water and it cannot withhold the temperature for a long time. By this, incorporation of some other legumes like soy flour to some extent may increase the cooking quality of the product. Hence, from this study it was concluded that this product can be a good replacement for the market product.

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