IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 13, Issue 11 Ser. I (November. 2019), PP 79-84
www.iosrjournals.org

Effect of Different Processing Techniques on the Amino Acid Profile of Black Gram

Nwosu[1], J.N., Anyaehie[1], M.A. and Ofoedu[1], C.E.
[1](*Department of Food Science and Technology, Federal University of Technology, Owerri, Nigeria)*
Corresponding author:Ofoedu, C.E.

Abstract:*The effects of different processing techniques such as boiling, soaking, blanching and roasting on the amino acid profile of black gram were studied. The raw seeds of black gram (Vignamungo) were boiled (at 100^{o}C for 60, 90 and 120 minutes),soaked (at 30^{o}C for 2, 4 and 6 hours),blanched (at 100^{o}C for 4, 8 and 12 minutes) and roasted at 80^{o}C for 30, 40 and 50 minutes). The amino acid profile of the processed and raw samples was determined using Amino Acid Analyzer.The processing treatments showed significant effect (P≤0.05) on each parameter. The result showed that 50 minutes roasting increased the amino acid composition of leucine, isoleucine,phenylalanine, tryptophan, valine, methione, aspartic acid, glutamic, alanine, cystine, histidine, serine, tyrosine, and arginine except for Aliphatic amino acids (proline and glycine) while 120 minutes boiling generally decreased the concentration of leucine, lysine, tryptophan, methionine, arginine and threonine content of black gram seeds when compared to the FAO requirement. Roasting showed increasing effect on glutamic and aspartic acid (14.16-14.99g/100g) and (13.09-13.44g/100g) respectively. Boiling, roasting, soaking and blanching significantly (p<0.05) reduce tyrosine and cystine content in black gram while histidine in black gram was increasedby the processing techniques. Based on these results, roastingtreatment is recommended for retention of amino acid composition in black gram preparation, not only for improving nutritional quality, but also for incorporation in food formulations.*

Keywords:*Black gram, amino acid, processing treatment, roasting, boiling, blanching, soaking*

Date of Submission: 18-11-2019 Date of acceptance: 04-12-2019

I. Introduction

Food legume crops serve as a vital crop for achieving food and nutritional security for both producers and consumers. They are an important component of agricultural food crops consumed in developing countries. In dietary terms, food legumes are components incorporated into cereal crops as a source of protein and minerals while agronomically, they serve as rotation crop with cereals, reducing soil pathogens and supplying nitrogen to the cereal crop[1].

A leguminosaegenus *Vigna*, contains several species that are of considerable economic importance in many developing countries and black gram (*V. mungo* (L.) Hepper) is one of the key dietary staple for many millions of people. Black gram (*Vigna mungo* (L.) *Hepper*) originated in India where it has been in cultivation from ancient times and is one of the most highly prized pulses in India and Pakistan. The seeds are eaten as pulses, direct or in various preparations such as whole, split, boiled or roasted. It could also be ground into flour for cake, bread or porridge. Legume such as black gram constitute an integral part of the staple diet and have a significant role in providing the bulk of protein and other rich nutrients such as vitamins, minerals, amino acids as well as dietary fibre[2]. This implies that its utilization is one of the simplest ways of combating malnutrition in developing countries.

Furthermore, some researchers have carried outdifferent works on black gram such as determination of the biochemical and functional characteristics of black gram cultivars in India[3], determining the effect of traditional methods of processing on the nutrient contents and some antinutritional factors in newly developed cultivars of black gram in India[4] while Wani*et al.*[5] investigated the physical and cooking characteristics of black gram cultivars grown in India; but there is limited research information on the amino acid profile of black gram.However, Girish *et al.*[6] investigated the nutritional composition, phenolic acid composition, carotenoid content, and also the antioxidant and α-glucosidase inhibition properties of the extract of black gram and its milled fractions viz., cotyledon, seed coat, germ, aleurone layer enriched in seed coat fraction and plumule.Black gram process into dehuskedcotyledon essentially involves the removal of germ, seed coats, aleuronelayer and plumule, which may consist of a varietyof nutrients. With an exception on the cotyledon fraction, the other fractionsare currently discarded or used as animal feed[6]. Moreover, the distribution of nutrientsand bioactive compounds in these fractions is not known.

In Nigeria, black gram is less studied as it is an underutilized specie of legume and it is almost going into extinction. Unlike other popular legumes like cowpea, black gram seed coats are hard to dehusk. This bottleneck in black gram processing could be the reason for its underutilization in this part of the world.Some researchers have recommended some processing methods such as soaking, blanching, boiling and roasting as pretreatments that can enhance easy dehusking/dehulling of the black gram seed coat. Black gram protein which shows well-balanced amino acid content to diets maybe affected by these pretreatments. Therefore the main objective of this research is to determine the effect of these pretreatment processes on the amino acid profile of black gram.

II. Materials and Methods

Procurement of Materials

Black gram (*Vigna mungo*) was purchased from 'After Nine' market in Enugu, Enugu State. The processing of samples and experiments were carried out using the facilities available at the laboratory of Department of Food Science and Technology, Federal University of Technology, Owerri and the laboratory of Department of Food Science and Technology, University of Jos. Reagents and other chemicals used were of analytical grade.

Sample Preparation

The Black gram seeds were sorted and thoroughly cleaned to remove broken seeds and foreign materials. Cleaned seeds were divided into four parts for the soaking, blanching, cooking and roasting pretreatment process.

Soaking:Black gram (1kg) was soaked in water at 30^{o}C for 2 hours and was repeated for 4 hours and 6 hours. The black gram seed was peeled manually to obtain the cotyledon and then dried in the oven (Gallenhamp OVB-300-010-9) at 65^{o}C until a constant weight was achieved. The sample was cracked hot with manual grinder, dehulled and pulverized. The flour was stored in air tight containers for further analysis.

Boiling:Black gram seeds (1kg) was soaked in water for 10 minutes in water and boiled at 100^{o}C for one hour, one hour 30 minutes and two hours respectively. The water was drained and the boiled seeds were allowed to cool for 30 min and then oven dried at 65^{o}C until a constant weight was achieved The sample was cracked hot with manual grinder, dehulled and pulverized. The flour was stored in air tight containers for further analysis.

Blanching:Black gram (1kg) was blanched in water at 100^{o}C for 4 min, 8 min and 12 min and then allowed to cool for 10 minute and oven dried at 65^{o}C until a constant weight was achieved. After oven drying at 65^{o}C, sample was cracked hot with manual grinder, dehulled and pulverized. The flour was stored in air tight containers for further analysis.

Roasting:Black gram (1kg) was placed in a hot open pan which was pre-heated on fire to ensure that sufficient and uniform heat was obtained for roasting.The heat processing continued and roasting was accomplished by constant stirring of seeds to ensure uniform application of heat and to prevent charring[7]. The seeds were roasted at 80^{o}C for 30 min, 40 min and 50 min. The sample was cracked hot with manual grinder, dehulled and pulverized. The flour was stored in air tight containers for further analysis.

Determination of Amino Acid

Amino acid analysis was determined according to the method described by Benitez[8]by using Applied Biosystems PTH Amino Analyzer and the concentrations of amino acids were calculated from chromatogram peaks.

Statistical analysis

Data obtained was subjected to one way analysis of variance using SPSS version 20 and means were separated using Fisher's Least Significant Difference (LSD).

III. Results and Discussion

The mean values of amino acid composition of the black gram samples as well as the individual mean separation of amino acid composition of raw, boiled, blanched, soaked and roasted black gram flour as affected by different pretreatment methods are presented in Tables 1, 2 and 3. Black gram protein was rich in essential amino acids; leucine, lysine, isoleucine, tryptophan, methionine, arginine, histidine, valine and threonine in different proportions. However, roasting black gram sample for 50 min improved the amino acid concentration of leucine, arginine and histidine with their highest mean value at 8.14 g/100g, 7.92 g/100g, and 3.32g/100g respectively. Soaking black gram seed for 6 h improved the concentrations of methionine and valine with their highest mean value at 1.34 g/100g, 5.00 g/100g respectively. Blanching for 4 min improved the Isoleucine content of the black gram sample with a mean value of 4.32 g/100g. Tryptophan recorded the highest mean value of 1.81 g/100g for undehulled control, while threonine recorded the highest mean value of 3.89g/100g for dehulled control.

On the other hand, for samples obtained from 120 min boiling; leucine, lysine, isoleucine, tryptophan, methionine, arginine and histidine had the least mean value of 5.02 g/100g, 4.88 g/100g, 3.01 g/100g, 0.81 g/100g, 0.80 g/100g, 5.51 g/100g, and 2.17g/100g respectively. Valine recorded the least mean value of 1.37g/100g for dehulled control. There were significant differences ($P<0.05$) in the amino acids amongst the treatments.

Glutamic acid and aspartic acid had the highest concentrations and both are acidic amino acids. This might be for their function as storage forms of nitrogen and precursors for the back bone of other amino acid[9]. Leucine constituted the highest single essential amino acid in all the samples. The most affected essential amino acid was methionine whose value was reduced 0.80-1.23g/100g though the roasting treatment improved the value more than the dehulled control sample. Boiling at 90 min gave the highest concentrations in Leucine (Leu), Lysine (Lys), Isoleucine (Ile), Phenylalanine (Phe), Tryptophan (Try), Valine (Val), Arginine (Arg), Tyrosin (Tyr), Histidine (His), and Cystine (Cys) while 60 min boiling had the highest concentration on the rest of the amino acid.

Blanching for 4 min significantly increased Glu, His, Tyr, Pro, Val, Ile, Met and Try which is not significantly different from 8 min blanching. Blanching for 8 min and 12 min had no significant difference ($p>0.05$) in the Lys content of the blackgram sample. Soaking for 6 h had highest concentrations of amino acids in aromatic, basic, acidic, hydroxylic, sulphur and aliphatic amino acids except for glycine and alanine which was better in 4 h soaking. There was no significant ($P<0.05$) difference in 4 h and 6 h soaking for tyrosine and histidine. The 4 h blanching gave highest concentration in Glu, His, Tyr, Ile, Met, Try, Lys while 12 min blanching constituted its highest concentration in Leu, Gly, Thr, Ser, Arg, Cys and Ala. There was no significant difference ($p>0.05$) for tryptophan and methionine in 4 min and 8 min blanched black gram flours. Blanching and soaking improved the concentration of lysine, isoleucine and histidine when compared to the dehulled control samples and it virtually met the FAO requirement for amino acid except the limiting amino amino acids of legume ie tryptophan and sulphur amino acids (methionine and cystine).Roasting for 50 min constituted the highest concentrations in leucine, isoleucine, phenylalnine, tryptophan, valine, methionine, aspartic acid, glutamic acid, alanine, cystine, histidine, serine, tyrosine, and arginine except for Aliphatic amino acids (proline and glycine) which had their highest concentrations in 40 min roasting while threonine and Lysine had theirs in 30 min roasting. The dehulled control amino acids were better concentrated in tyrosine, cystine and threonine than the processed black gram flours. Arginine aspartic acid, serine, glutamic acid, proline, alanine and leucine were better in roasted than in the controls and other processing techniques.

Table 1: Mean Value of the Amino Acid Composition of Black Gram Samples as Affected by Different Pretreatment Methods

Sample	Leucine (g/100g)	Lysine (g/100g)	Isoleucine (g/100g)	Phenylalanine (g/100g)	Tryptophan (g/100g)	Valine (g/100g)
FAO Requirement	6.60	5.80	2.80	6.30	1.10	3.50
Boiling 60 min	5.49^{b}±0.014	5.17^{b}±0.028	3.31^{b}±0.014	3.28^{b}±0.028	0.95^{b}±0.014	3.80^{a}±0.014
Boiling 90 min	5.54^{a}±0.014	5.52^{a}±0.014	3.60^{a}±0.014	3.37^{a}±0.028	1.05^{a}±0.028	3.80^{a}±0.028
Boiling 120 min	5.02^{c}±0.028	4.88^{c}±0.014	3.01^{c}±0.014	3.19^{c}±0.028	0.81^{c}±0.014	3.57^{b}±0.028
LSD	**0.06**	**0.06**	**0.05**	**0.09**	**0.06**	**0.08**
Blanching 4 min	6.65^{c}±0.014	6.74^{a}±0.028	4.32^{a}±0.014	3.90^{b}±0.014	1.21^{a}±0.014	4.79^{a}±0.028
Blanching 8 min	7.18^{b}±0.014	6.68^{a}±0.014	3.60^{c}±0.028	4.17^{a}±0.028	1.26^{a}±0.014	4.50^{b}±0.014
Blanching12 min	7.30^{a}±0.014	6.76^{a}±0.028	4.26^{b}±0.014	3.90^{b}±0.028	1.00^{b}±0.028	4.53^{b}±0.028
LSD	**0.05**	**NS**	**0.06**	**0.08**	**0.06**	**0.08**
Soaking 2 h	6.42^{c}±0.028	5.94^{c}±0.014	3.86^{b}±0.028	3.81^{c}±0.014	1.13^{c}±0.014	3.92^{c}±0.028
Soaking 4 h	6.71^{b}±0.028	6.36^{b}±0.014	3.99^{a}±0.014	4.08^{b}±0.028	1.21^{b}±0.028	4.30^{b}±0.014
Soaking 6 h	7.00^{a}±0.014	6.92^{a}±0.014	3.93^{a}±0.014	4.41^{a}±0.007	1.31^{a}±0.014	5.00^{a}±0.028
LSD	**0.08**	**0.05**	**0.06**	**0.06**	**0.06**	**0.08**
Roasting 30 min	6.95^{c}±0.014	7.05^{a}±0.014	3.99^{b}±0.028	3.81^{b}±0.028	1.34^{b}±0.014	4.59^{b}±0.014
Roasting 40 min	7.30^{b}±0.014	6.50^{b}±0.014	3.31^{c}±0.014	3.72^{b}±0.028	1.21^{c}±0.014	4.50^{c}±0.014
Roasting 50 min	8.14^{a}±0.014	7.00^{a}±0.028	4.32^{a}±0.014	4.97^{a}±0.023	1.55^{a}±0.014	4.94^{a}±0.028
LSD	**0.05**	**0.06**	**0.06**	**0.09**	**0.05**	**0.06**
Control (Undehulled)	6.48±0.028	6.66±0.014	3.90±0.014	3.55±0.028	1.81±0.028	4.03±0.028
Control (Dehulled)	7.53±0.014	6.36±0.028	3.80±0.042	4.70±0.014	1.37±0.028	5.44±0.028

a,b,c Means on the same row with different superscript are significantly different ($p<0.05$)
Note: FAO Requirement was according to FAO Pattern[14].

Table 2: Amino Acid Composition as affected by different Pretreatment Methods Continued

Sample	Arginine (g/100g)	Tyrosine (g/100g)	Histidine (g/100g)	Cystine (g/100g)	Alanine (g/100g)	Glutamic acid (g/100g)
FAO Requirement	-	6.30	1.90	2.50	-	-
Boiling 60 min	5.85^{b}±0.028	3.27^{b}±0.014	2.20^{b}±0.014	0.79^{a}±0.028	3.94^{a}±0.014	12.49^{a}±0.014
Boiling 90 min	6.54^{a}±0.014	3.44^{a}±0.014	2.62^{a}±0.028	0.85^{a}±0.014	3.83^{b}±0.014	11.58^{b}±0.028
Boiling 120 min	5.51^{c}±0.014	2.93^{c}±0.028	2.17^{c}±0.028	0.73^{b}±0.014	3.57^{c}±0.028	11.13^{c}±0.028
LSD	**0.06**	**0.06**	**0.08**	**0.06**	**0.06**	**0.08**
Blanching 4 min	6.88^{b}±0.028	3.79^{a}±0.014	3.07^{a}±0.014	0.97^{b}±0.028	3.87^{b}±0.014	14.00^{a}±0.028
Blanching 8 min	6.88^{b}±0.014	3.61^{b}±0.028	2.84^{b}±0.014	0.91^{b}±0.014	3.87^{b}±0.028	13.93^{b}±0.014
Blanching 12 min	7.05^{a}±0.028	3.61^{b}±0.014	2.81^{b}±0.014	1.09^{a}±0.028	4.29^{a}±0.014	13.70^{c}±0.014
LSD	**0.08**	**0.06**	**0.05**	**0.08**	**0.06**	**0.06**
Soaking 2 h	6.71^{c}±0.028	3.44^{b}±0.014	2.75^{b}±0.028	0.91^{b}±0.028	4.17^{b}±0.014	12.79^{c}±0.014
Soaking 4 h	6.88^{b}±0.042	3.61^{a}±0.014	2.91^{a}±0.028	0.97^{b}±0.014	4.44^{a}±0.028	13.02^{b}±0.028
Soaking 6 h	7.23^{a}±0.014	3.61^{a}±0.042	2.94^{a}±0.014	1.09^{a}±0.014	3.94^{c}±0.014	13.78^{a}±0.028
	0.10	**0.09**	**0.08**	**0.06**	**0.06**	**0.08**
Roasting 30 min	7.31^{b}±0.014	3.78^{a}±0.028	3.13^{b}±0.028	1.15^{ab}±0.028	4.17^{c}±0.028	13.93^{c}±0.028
Roasting 40 min	7.23^{c}±0.028	3.61^{b}±0.028	3.00^{c}±0.028	1.09^{b}±0.028	4.82^{b}±0.028	14.00^{b}±0.014
Roasting 50 min	7.92^{a}±0.014	3.79^{a}±0.014	3.32^{a}±0.014	1.21^{a}±0.014	5.01^{a}±0.014	14.99^{a}±0.014
	0.06	**0.08**	**0.08**	**0.08**	**0.08**	**0.06**
Control (Undehulled)	7.05±0.028	3.96±0.028	2.20±0.028	1.09±0.042	4.32±0.014	13.63±0.014
Control (Dehulled)	7.57±0.028	3.96±0.014	2.30±0.014	1.33±0.014	4.55±0.014	14.16±0.028

a,b,c Means on the same row with different superscript are significantly different ($p<0.05$)
Note: FAO Requirement was according to FAO Pattern[14].

Table 3: Amino Acid Composition as affected by Different Pretreatment Methods Continued

Sample	Glycine (g/100g)	Threonine (g/100g)	Serine (g/100g)	Aspartic acid (g/100g)	Methionine (g/100g)	Proline (g/100g)
FAO Requirement	-	3.40	-	-	2.50	-
Boiling 60 min	3.71^{a}±0.014	3.25^{a}±0.028	3.30^{b}±0.014	10.92^{a}±0.028	0.85^{b}±0.014	3.45^{b}±0.014
Boiling 90 min	3.56^{b}±0.014	3.11^{b}±0.014	3.40^{a}±0.028	10.48^{b}±0.014	0.96^{a}±0.028	3.55^{a}±0.028
Boiling 120 min	3.25^{c}±0.028	2.61^{c}±0.014	3.00^{c}±0.028	10.05^{c}±0.028	0.80^{b}±0.028	2.94^{c}±0.028
LSD	**0.06**	**0.06**	**0.08**	**0.08**	**0.08**	**0.08**
Blanching4 min	3.90^{b}±0.014	3.61^{b}±0.028	3.84^{b}±0.014	12.72^{b}±0.028	1.28^{a}±0.028	3.96^{a}±0.014
Blanching8 min	3.42^{c}±0.014	3.25^{c}±0.014	3.53^{c}±0.014	13.02^{a}±0.028	1.23^{a}±0.014	3.86^{b}±0.028
Blanching 12 min	3.99^{a}±0.014	3.77^{a}±0.014	3.94^{a}±0.028	11.94^{c}±0.028	1.07^{b}±0.028	3.86^{b}±0.014
LSD	**0.05**	**0.06**	**0.06**	**0.09**	**0.06**	**0.06**
Soaking 2 h	3.85^{b}±0.014	3.28^{b}±0.028	3.54^{b}±0.014	12.53^{b}±0.014	0.99^{b}±0.014	3.66^{c}±0.014
Soaking 4 h	4.16^{a}±0.028	3.25^{b}±0.014	3.59^{b}±0.014	12.31^{c}±0.028	0.96^{b}±0.014	3.76^{b}±0.028
Soaking 6 h	3.90^{b}±0.028	3.77^{a}±0.014	4.00^{a}±0.014	12.90^{a}±0.014	1.34^{a}±0.028	3.86^{a}±0.028
LSD	**0.08**	**0.06**	**0.05**	**0.06**	**0.06**	**0.08**
Roasting 30 min	3.94^{c}±0.014	3.75^{a}±0.028	4.00^{b}±0.028	12.65^{c}±0.028	1.20^{b}±0.014	4.26^{b}±0.014
Roasting 40 min	4.66^{a}±0.028	3.39^{c}±0.014	4.00^{b}±0.014	13.02^{b}±0.028	0.91^{c}±0.014	5.65^{a}±0.014
Roasting 50 min	4.32^{b}±0.028	3.61^{b}±0.014	4.30^{a}±0.014	13.44^{a}±0.155	1.34^{a}±0.014	3.96^{c}±0.014
LSD	**0.08**	**0.06**	**0.06**	**0.30**	**0.05**	**0.05**
Control (Undehulled)	4.04±0.028	3.80±0.028	4.11±0.014	12.90±0.014	1.12±0.028	3.86±0.014
Control (Dehulled)	4.32±0.014	3.89±0.028	4.16±0.028	13.09±0.028	1.23±0.014	4.04±0.028

a,b,c Means on the same row with different superscript are significantly different ($p<0.05$)
Note: FAO Requirement was according to FAO Pattern[14].

Thus, changes in amino acids profile could be as a result of transamination and deamination reactions and these changes could be attributed to loss in toxic activity during cooking process, particularly for the pertinacious toxins, trypsin inhibitors and haemaglutinnins[10]. As heating proceeds, protein quality in arginine increases to a maximum of 6.54g/100g at 90 min boiling before declining again to 5.51g/100g at 120 min with continued heating, thus reduction is likely to be related to increasing maillard browning which causes lysine to be rendered unavailable. Aremu*et al.*[11], Audu and Aremu[12] and Hefnawy[13] also recorded that cooking treatments decreased the concentration of lysine, tryptophan, and total aromatic and Sulphur amino acids.

From the results, it could be observed that boiling generally reduced the essential amino acid content of black gram samples as compared to the FAO requirement[14], except for isoleucine and valine. However, all other treatments (soaking, blanching and roasting) recorded high mean values in leucine, lysine, isoleucine,

tryptophan and valine when compared to the FAO requirement in Table 1, except for phenylalanine and tryptophan in 12min blanching. The observed decrease in amino acid content of black gram treated with boiling could be as a result of leaching of soluble proteins into the boiling water. This is in line with the report of Geervani and Theophilus[15] which stated that wet heat cooking methods caused nutrient losses especially proteins. Generally, boiling reduces amino acid composition of black gram flour sample, especially boiling at 120 min. This could be attributed to the Amadori rearrangement and formation of D-Amino acids at high and prolonged heat treatment[16].

Moreover, roasting as a treatment method for black gram recorded the highest mean values for leucine, lysine, arginine and histidine. According to Geervani and Theophilus[15], dry heating process such as roasting reduces nutrient losses.

According to FAO[14], the recommended daily allowance (RDA) for leucine is 6.60 which were higher than the average mean values of leucine obtained for boiling (5.35g/100g) and soaking (6.71g/100g), but lower than blanching (7.04g/100g), roasting (7.46g/100g) and control (7.01g/100g). Also, the RDA for isoleucine is 2.80, FAO[14], which was lower than the average mean values of isoleucine obtained for all the treatments in present study. Meanwhile, high leucine content in diet impairs tryptophan and niacin metabolism which might be a factor in pellagra development and niacin deficiency in sorghum consumers[17,18]. On the other hand, boiling significantly ($P<0.05$) reduced the leucine content of black gram from average mean value of 7.01g/100g (Control) to 5.35g/100g (Boiling). This shows that boiling could significantly ($P<0.05$) reduce leucine content, thus helping to combat pellagra development and niacin deficiency. Igwe*et al.*[19] reported that animals fed sorghum proteins containing less than 110 mg/gcp of leucine did not suffer from nicotinic acid deficiency. Interestingly, the highest leucine level at 81.40mg/gcp studied was not up to this critical level.

Furthermore, all the treatment methods recorded lower mean values for tyrosine and cystine when compared to the FAO requirement while histidine recorded high mean values for all the treatment methods when compared to the FAO requirement. An inference could be drawn from the above observations that treatment methods such as boiling, roasting, soaking and blanching could significantly ($p<0.05$) reduce tyrosine and cystine content in food samples while histidine can be significantly increased ($p<0.05$) in food samples during processing.

Generally, leucine, total sulphur amino acids, threonine and valine were slightly more abundant in black gram protein as compared to the reference pattern for all treated samples except in boiled samples for leucine. It was observed that boiling significantly ($p<0.05$) reduced the amount of leucine.

IV. Conclusion

Processing treatments (boiling, blanching, soaking and roasting) significantly influenced the amino acid levels in black gram.Roasting black gram for 50 min increased the concentrations of Leu, Ile, Phe, Try, Val, Met, Asp,Glu, Ala, Cys, His, Ser, Tyr and Arg; roasting for 40 min increased the Aliphatic amino acids (proline and glycine) while threonine and Lysine had were increased by 30min roasting. However, boiling, soaking and blanching significantly reduced tyrosine andcystine content in black gram.Blanching and soaking treatment improved the concentrations of lysine, isoleucine and histidine when compared to the dehulled control samples and it virtually met the FAO requirement for amino acid except the limiting amino amino acids of legume.

Generally, boiling reduced most of the essential and non-essential amino acids while roasting enhanced the amino acid profile of black gram. Roasting treatment is recommended for retention of amino acid composition in black gram preparation, not only for improving nutritional quality, but also for incorporation in food formulations.

References

[1]. Beebe, S. (2010). Successes and Challenges in Improving Common Bean Productivity. Http://Www.Cgiar.Org/Pdf/Beebe-%20summary-Challenges%20in%20bean%20improvement.Pdf, AccessedOctober 4, 2019.
[2]. Urga K., Fufa H., Biratu E., and Gebretsadik M. (2006), "Effects of blanching and soaking on some physical characteristics of grass pea (Lathyrussativus)", African Journal of Food Agriculture Nutrition and Development.
[3]. Modgil, R., Shilpa, K and Anupama, S. (2019). Biochemical and functional characteristics of Black gram (Vignamungo) cultivars grown in Himachal Pradesh India. Int. J. Curr. Microbiol. App. Sci, 8 (4): 2126-2137.
[4]. Deka, S. C., Kakati, P., Kotoki, D. and Saikia, S. (2010). Effect of traditional methods of processing on the nutrient contents and some anti-nutritional factors in newly developed cultivars of green gram [Vignaradiate (L)] International Food research Journal 17(2): 377-384.
[5]. Wani, I.A., Dalbir, S.S. and Gill, B.S. (2013). Physical and cooking characteristics of black gram (Phaseolusmungoo L.) cultivars grown in India. International Journal of Food Science and Technology 48(12): 1-14.
[6]. Girish, T.K., Pratape, V.M. and Prasada Rao, U.J.S. (2012). Nutrient distribution, phenolic acid composition, antioxidant and alpha-glucosidase inhibitory potentials of black gram (Vigna mungo L.) and its milled by-products. Food Research International 46: 370-377.
[7]. Eyo, A.A. (2001). Chemical Composition and Amino Acid Content of the Commonly Available Feedstuffs Used in Fish Feeds in Nigeria. In: Eyo, A.A. (ed.) Proceedings of the First National Symposium on fish Nutrition and Fish Technology, Nigerian Institute for Oceanographic and Marine Research (NIOMR), LAGOS. Published by Fisheries Society of Nigeria (FISON). Pp 58-71.

[8]. Benitez, L. V. (1989). Amino Acid and fatty acid profiles in aquaculture nutrition studies, p. 23-35. In S.S. De Silva (ed.) Fish Nutrition Research in Asia. Proceedings of the third Asian Fish Nutrition Network meeting. Asia fish. Society Special Publication. 4, 166p.
[9]. Onwuliri, V. A. And Anekwe, G. E. (1993). Amino acid composition of B. Pinnatum (Linn.). Medical Science Research, 21: 507-508.
[10]. Liener, I.E. (1994). Implications of antinutritional components in soybean foods. Critical Review of Food Science and Nutrition 34: 31– 67.
[11]. Aremu, M. O., Olaofe, O., Basu, S. K., Abdulazeez, G. and Acharya, S. N. (2010). Processed cranberry bean (Phaseoluscoccineus) seed flours for African diet. Canadian Journal of Plant Science, 90: 719 – 728.
[12]. Audu, S. S. and Aremu, M. O. (2011). Nutritional composition of raw and processed pinto bean (Phaseolus vulgaris L.) grown in Nigeria. Journal of Food, Agriculture and Environment, 9(3&4): 72 – 80.
[13]. Hefnawy, T. H. (2011). Effect of processing methods on nutritional compositionand anti-nutritional factors in lentils (Lens culinaris) Annals of Agricultural Science 56(2): 57–61
[14]. FAO/WHO (1991). Protein quality evaluation, (p 66). Rome, Italy: food and Agricultural Organization of the United Nations
[15]. Geervani, P. and Theophilus, F. (1980) Effect of home processing on the protein quality of selected legumes. Journal of Food Science 45:707-710.
[16]. Olaofe, O., Adeyemi, F. O., and Adediran, G. O. (1994) Amino acid and mineral compositions and functional properties of some oil seeds. J Agric Food Chem, 42: 878-881.
[17]. FAO (1995). Sorghum and millets in human nutrition. United Nations FAO Food Nutrition Series, No. 27. Food and Agriculture Organization of the, Rome, Italy.
[18]. Belavady. B. and Udayasekhara Rao P (1979). Leucine and isoleucine content of Jowar and its pellagragenicity. Indian J ExpBiol 17; 659-661. Chem., 105: 1357-1363.
[19]. Igwe, C.U., Ojiako, A.O., Anugweje, K.C., Nwaogu, L.A. and Ujowundu, C.O. (2012). Amino acid profile of raw and locallyprocessed seeds of ProsopisafricanaandRicinuscommunis: Potential Antidotes to protein malnutrition. Functional Foods inHealth and Disease, 2(4): 107-119.

Nwosu ."Effect of Different Processing Techniques on the Aminio Acid Profile of Black Gram."IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) 13.11 (2019): 79-84.