
Amino Acid Composition and Nutritional Value of Seed Proteins in Sesame (*Sesamum Indicum* L.) Cultivars Grown in Vietnam

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Abstract Seeds of six sesame cultivars collected from different provinces of Vietnam were used for the research. The sesame seeds were selected, dehydrated, ground and stored at 4°C for analyses. The samples were hydrolyzed. The analysis of total amino acid contents and amino acid composition were carried out with precolumn derivatization technique (in HP - Amino Quant Series II, Hewlett Packard) using ortho-phthalaldehyde (OPA) for primary amino acids and 9-fluorenyl methyl chloroformat (FMOC) for secondary amino acids. The results shown that the total seed amino acid contents of the six cultivars ranged from 17.25 to 21.98%. Among six cultivars, the highest total amino acid contents was were observed in seed of two cultivars, V5 (21.98%) and V14 (21.60%). The seeds of V8 cultivar contained the smallest total amino acid contents (17.25%). All essential amino acids were found in the seeds of six examined sesame cultivars. The contents of these amino acids in seed proteins were approximate or higher in compared to FAO standard protein. The seed proteins of these six sesame cultivars had good nutritional values based on the high content of essential amino acids, lysine and leucine especially.

Keywords: total amino acid contents, essential amino acids, sesame (*Sesamum indicum* L.), local cultivars

Introduction

Sesame (*Sesamum indicum* L.), belonging to *Sesamum* genus, Pedaliaceae family, is an annual plant. This crop plant is originated from Africa or India. Currently, sesame is still grown worldwide in around 70 countries including 26 African and 24 Asian nations. The total cultivation area in the world of sesame covers about 9.4 million hectares with the total sesame

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production of over 4.8 million tons (FAOSTAT 2013). In Vietnam, the sesame cultivation area is covered by 42,841 hectares with the total production of about 33,223 tons (FAOSTAT 2013). Sesame is known as “the queen of oil producing plants” (Bahkali *et al.*, 1998; Röbbelen *et al.*, 1989), with its main product as sesame seeds. Apart from its principal value of oil, on average 20-30% of protein comes from sesame seeds (Nguyen *et al.*, 2003; Röbbelen *et al.*, 1989). Furthermore, sesame proteins includes eight essential amino acids, with about 3.4% of methionine (Chung *et al.*, 1995; Kang *et al.*, 2003) that is higher than that in soya beans, chicken eggs or peanuts (Serretti *et al.*, 1994). In addition, Sesame seeds contain many mineral elements and vitamins (Kanu, 2011). That is why ground sesame seeds are usually used as a supplementary food against infant malnutrition (Dang *et al.*, 1997). Sesame proteins are found useful to human health (El-Adawy, 1995; Elleuch *et al.*, 2011). Consumption of whole sesame seeds help to increase plasma γ -tocopherol and enhance vitamin E activity, which is thought to prevent cancers and heart diseases (Cooney *et al.*, 2001). Sesame also has positive effects on sex hormone, anti-oxidant status and blood lipids in postmenopausal women (Wu *et al.*, 2006). Consumption of α -globulin isolated from sesame proteins of a low lysine/arginine ratio significantly reduces blood cholesterol and harmful lipids (Prakash and Nandi, 1982). To date, many works were performed to carry out the compositions of sesame seeds including proteins and amino acids (Kanu, 2011; Le *et al.*, 2005; Nguyen *et al.*, 2002; Nguyen *et al.*, 2003; Serretti *et al.*, 1994; Zebib *et al.*, 2015). In Vietnam, the seeds of some local sesame cultivars were possessed high protein and amino acid contents (Nguyen *et al.*, 2003). The aim of this work is to investigate the amino acids profile in other local cultivars currently grown in North Central Coast of Vietnam.

Material and methods

Seeds of six sesame cultivars were collected in some provinces in North Central Coast of Vietnam by the Department of Crop Seed Library, Plant Genetic Resources Center, Vietnam Academy of Agricultural Sciences, including V3 (code 4585, collected from Kỳ Anh, Hà Tĩnh province), V5 (code 4589, collected from Dakrong, Quảng Trị province), V8 (code 4597, collected from Phú Lộc, Thừa Thiên Huế province), V10 (code 6863, collected from Tĩnh Gia, Thanh Hóa province), V14 (code 7788, collected from Thọ Xuân, Thanh Hóa province), V17 (code 8354, collected from Diễn Châu, Nghệ An province). Among them, V3, V10 and V14 are black sesame and V5, V8 and V17 are white sesame.

Sesame seeds were selected, dehydrated, ground and stored at 4°C as for the following analysis. Using the method described by Nguyen et al (Nguyen *et al.*, 2002), total amino acid contents in sesame seeds were determined with derivatization with OPA (Ortho-phthaldialdehyde) for primary amino acids and with FMOC (9-fluorenyl methyl chloroformate) for secondary amino acids on HP - Amino Quant Series II (Hewlett Packard).

Results and discussion

Amino acid content in sesame seeds

Since a long time, sesame proteins have been known as good food and have been used as a precious plant protein source. Especially, the presence of essential amino acids has contributed to increase sesame nutritional values. In this work, the total amino acid contents in seed of the six examined sesame cultivars collected in North Central Coast of Vietnam were analyzed.

Table 1. Total amino acid contents in the six examined sesame cultivars (g amino acid/100g of seed)

Amino acid		Cultivars					
		V3	V10	V14	V5	V8	V17
Non essential amino acids	Aspartic acid	1.64	1.58	1.51	1.70	1.35	1.73
	Glutamic acid	4.03	5.00	4.48	4.88	3.17	4.97
	Serine	0.99	0.97	1.13	1.02	0.81	1.00
	Histidine	0.68	0.42	0.64	0.70	0.61	0.68
	Glycine	1.19	1.16	1.22	1.25	1.00	1.24
	Alanine	1.03	1.00	1.04	1.07	0.86	1.06
	Arginine	2.69	2.64	2.53	2.80	2.17	1.93
Essential amino acids	Proline	0.71	0.71	0.70	0.66	0.63	0.75
	Valine	1.14	1.06	1.18	1.18	0.99	1.13
	Methionine	0.44	0.46	0.67	0.50	0.49	0.44
	Phenylalanine	1.11	1.06	1.16	1.14	0.93	1.13
	Isoleucine	0.80	0.82	0.86	0.85	0.69	0.82
	Leucine	1.53	1.56	1.63	1.59	1.32	1.56
	Lysine	0.95	1.00	1.23	0.99	0.85	0.96
	Threonine	0.82	0.84	0.83	0.85	0.71	0.83
	Tyrosine	0.52	0.56	0.53	0.54	0.44	0.63
	Cysteine and Cystine	0.25	0.27	0.26	0.26	0.23	0.26
Total	20.52	21.11	21.60	21.98	17.25	21.12	

The results (table 1) show that the total amino acid contents in the sesame seeds of the analyzed cultivars ranging from 17.25% to 21.98%. Among six analyzed cultivars, the V5 seeds exhibit highest amino acid content (21.98%), followed by V14 (21.60%). Two cultivars, V10 and V17, have lower contents of amino acids at 21.11% and 21.12% respectively. There is no significant difference of the total amino acid content between the file sesame cultivars V5, V14, V17, V10 and V3. The cultivar which has the lowest total amino acid content in seed is V8 (17.25%). The six analyzed sesame cultivars exhibit total amino acids contents like others sesame cultivars grown in Vietnam, ranging about 20% (Le *et al.*, 2005; Nguyen *et al.*, 2002, 2003). In compared with other plants, sesame seeds include the total amino acid content higher than rice seeds (7 – 8%) but lower than soya beans (35 – 40%) and green beans (22 – 25%) (Dang *et al.*, 1997; Sharmila *et al.*, 2007).

A total of 17 amino acids were detected in the seeds of all six studied sesame cultivars. Tryptophane was not detected probable result of degradation in hydrolysis process. At the opposite, the high levels of glutamic acid, arginine and aspartic acid in the sesame seeds share the same result reported by Nguyen *et al.* (Nguyen *et al.*, 2003). Maneemegalai and Prasad reported high contents of Aspartic acid, Arginine and Glutamine in sesame seed meal collected from Chengalpet, Tamilnadu, India (Maneemegalai and Prasad, 2011). Among the essential amino acids, leucine exhibits high content in the seeds of all studied sesame cultivars like in the seeds of others imported and local sesame cultivars grown in Vietnam (Nguyen *et al.*, 2002, 2003). Le *et al.* reported that there are all 8 essential amino acids with high total amino acid contents in sesame seeds (Le *et al.*, 2005). Seeds of six studied sesame cultivars have a rather high lysine content (ranging from 0.85 to 1.25%) in agreement with the previous reports (El-Adawy, 1995; Nguyen *et al.*, 2003).

Evaluation of nutritional values of seed proteins

The nutritional value of a food protein actually was evaluated by the proportion of amino acid components, based on the percentage of essential amino acids especially. The proportion of essential amino acids was expressed by the rate of gramme amino acid per 100 grammes of protein (FAO/WHO/UNU, 1991).

Table 2. Amino acid contents in sesame proteins of 6 research cultivars (g amino acid/100g protein)

Amino acid	Cultivars						FAO standard	
	V3	V10	V14	V5	V8	V17		
Non essential amino acids	Aspartic acid	7.99	8.19	6.99	7.73	7.83	7.48	
	Glutamic acid	19.6	23.5	20.7	22.2	18.3	23.6	
		4	3	4	0	8	9	
	Serine	4.82	4.73	5.23	4.64	4.69	4.59	
	Histidine	3.31	3.22	2.96	3.18	3.54	1.99	
	Glycine	5.79	5.87	5.65	5.69	5.79	5.50	
	Alanine	5.02	5.02	4.81	4.67	4.98	4.74	
	Arginine	13.1	9.14	11.7	12.7	12.5	12.5	
		1		6	4	8	1	
	Proline	3.46	3.55	3.24	3.00	3.65	3.36	
Essential amino acids	Valine	5.56	5.35	5.46	5.37	5.74	5.02	4.20
	Methionine	2.14	2.08	3.10	2.27	2.84	2.18	2.20
	Phenylalanine	5.41	5.35	5.37	5.19	5.39	5.02	2.80
	Isoleucine	3.89	3.88	3.98	3.87	4.00	3.88	4.20
	Leucine	7.46	7.39	7.55	7.23	7.65	7.39	4.20
	Lysine	4.63	4.55	5.69	4.50	4.93	4.74	4.20
	Threonine	3.99	3.93	3.84	3.87	4.12	3.98	2.80
	Tyrosine	2.53	2.98	2.45	2.47	2.55	2.65	2.80
	Cysteine and Cystine	1.22	1.23	1.20	1.18	1.33	1.28	2.00

The ratio of grammes of all amino acids/100 grammes of proteins was showed in table 2.

Glutamic acid, arginine, leucine and aspartic acid are four the highest concentration amino acids in sesame seeds protein. This result is consistent with previous works (Kanu, 2011; Nguyen *et al.*, 2003). The concentration of Glutamic acid in the seed proteins of examined sesame cultivars is higher than that of other sesame cultivars grown in Vietnam and China. However, Arginine concentration is lower than that in sesame seed proteins studied by (Nguyen *et al.*, 2003) but is three folds higher than two china cultivars studied by (Kanu, 2011).

Compared to FAO Standard for protein, most of essential amino acids in seed proteins of six examined cultivars sesame were higher, except Isoleucine, Tyrosine, Methionine and Cysteine. The content of these four amino acids are less than FAO standard in seeds of some examined cultivars.

To date, previous works showed only white sesame grown in China (Kanu, 2011) and black sesame from Binh Dinh Vietnam (Nguyen *et al.*, 2003) have higher concentration of Isoleucine in compared to FAO Standard. At the opposite, Methionine concentration in literature was higher FAO Standard while our data showed that only three cultivars, V5, V8 and V14 exhibited higher concentration of this amino acid than FAO Standard. Lysine, an important amino acid, is quite richer than other sesame cultivars studied by (Nguyen *et al.*, 2003). This work suggests that sesame seeds are really a nutrition source of essential amino acids, especially lysine, for humans and animals.

Conclusion

Amino acid composition and contents in sesame proteins of six cultivars are well-proportioned. Total amino acid contents of six sesame cultivars are 17.7% - 21.98%, of which V5 and V14 cultivars have the highest amino acid contents of 21.98 and 21.60% respectively. V3 and V8 have the lowest amino acid contents of 20.52% and 17.25% respectively. In sesame seeds, there are all essential amino acids and the ratio of these amino acids in seed proteins of the six research sesame cultivars is beyond or almost similar to FAO standards.

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