

AMINO ACID COMPOSITION OF PROTEIN AND ITS BIOLOGICAL VALUE IN SEEDS OF PEANUT SORTS WIDEN IN UKRAINE

Antonina Dubinina, Svitlana Lehnert, Olga Khomenko

1Kharkiv State University of Food Technology and Trade

Klochkivska str., 333, 61051, Kharkiv, Ukraine

Abstract

Amino acid composition of protein in 19 sorts of peanuts, widen in Ukraine is qualitatively determined. Amino acid score (AS), divergence coefficient of amino acid score (DCAAS) and biological value (BV) for the given sorts are calculated. Glutamic acid and arginine prevails in amino acid composition of peanuts. It is shown that proteins of peanuts are characterized by low content of methionine and cysteine. The sorts with the highest biological value of protein are determined.

Key words: amino acids, biological value, peanut (*Arachis hypogaea*)

1. INTRODUCTION

At present the world witnesses the deficit of dietary protein, and its deficiency will remain at the same level in the nearest future. Insufficient provision of population with the products containing complete protein results in hard specific diseases, mostly among children. The analysis of modern condition of Ukrainian people alimentation proves negative tendencies, which are characterized by the reduction of caloric capacity of rations, changes of their structure because of the reduction of consuming most of food products and nutrients, deficiency of three essential amino acids (tryptophan, methionine, and valine) that can negatively influence biosynthesis of hemoglobin, evoke disturbance of nervous system, metabolism, physical development, decrease in immunity, and cause alimentary stipulated diseases (anemia, endocrine diseases, nutritional dystrophy and other diseases) (Moskalenko, Gruzeva, Galienko, 2009).

Animal products and some leguminous crops are the main source of proteins for humans. Biological value of proteins depends on the type of raw material that is a crucial factor for drawing up a daily diet and substantiating norms for consuming animal and vegetable proteins.

Peanut is the fourth most important source of nutritive oil and the third source of vegetable protein by the importance (Atasie, Akinhanmi, Ojiodu, 2009).

It is determined that regular consumption of peanuts positively influences the reduction of diabetes of II type (Jiang, Manson, Stampfer, Liu, Willett, Hu, 2002), cardiovascular diseases (Kris-Etherton et al., 1999; Alper, Mattes, 2003), diseases of large intestine (Kris-Etherton et al., 1999; Alper, Mattes, 2003), prostate and breast cancer (Awad, Chan, Downie, Fink, 2000). Peanuts also help reducing development of osteoporosis, and serves the source of protein (Messina, 1999).

Content of peanut protein fluctuates within 15,4 to 30,2%. This discrepancy largely depends on genotype and conditions of growth (Singh, Singh, 1991). Peanuts protein is easily digestible. Its main mass consists of globulins: arachin and conarachin. Biological value of peanuts proteins is connected with the amount of essential amino acids in them, which are required for life activity of a human but cannot be synthesized by the organism itself. Large content of major essential amino acids brings peanut proteins nearer to animal ones. Peanut proteins are characterized by large amount of water-soluble fractions that indicates high level of their digestibility (Mykhailov, Vershynina, Roslyakov, Gonchar, 2004).

In the literature it is noted that peanut seeds are a good source of arginine, glycine, leucine, alanine and methionine. Other amino acids are found in small amounts. Thus, results of Natarajan's (1980) investigations demonstrated rather high level of leucine (6,4 g/100 g of protein), phenylalanine (5,0 g/100 g of protein) and valine (4,2 g/100 g of protein). Tyrosine is contained 3,9 g/100 g of protein, lysine 3,5 g/100 g of protein, a little smaller is the amount of isoleucine - 3,4 g/100 g of protein and threonine - 2,6 g/100 g of protein.

The scientists Ingale and Shrivastava (2011) bred JL-24 sort adapted for India. Research of amino acid composition means that *Arachis hypogaea* of JL-24 sort contains the largest amount of proline (6,412 g/100 g of

protein), the next is asparagine or aspartic acid (3,459 g/100 g of protein), arginine (2,795 g/100 g of protein). Glutamic acid, glycine, alanine, valine, isoleucine, leucine, phenylalanine fluctuated within 1,792 g/100 g of protein to 1,001 g/100 g of protein, the following amino acids were revealed in descending order: threonine, cystine, tyrosine, histidine, lysine, tryptophane. Serine was not revealed.

The scientists from Mexico Campos-Mondragón, Calderón De La Barca et al. (2009) studied amino acid composition of peanut seeds. They investigated 6 new sorts of peanut. Glutamic acid (177 mg/g of protein), asparagine or aspartic acid (114 mg/g of protein) and arginine (125 mg/g of protein) were the predominant amino acids in the peanut sorts under research. The results of the carried out researches demonstrated that VA-81-B contains high level of lysine (43,5 mg/g of protein) and threonine (21 mg/g of protein). Limiting acids were lysine – 38,3 mg/g of protein (Ranferi Díaz sort), threonine – 9,8 mg/g of protein (Florunner sort).

In Florida peanuts of 6 highly oleinic (79-82% oleinic acid) and 10 common sorts containing fatty acids and amino acids were investigated. Glutamic and aspartic acids constitute 36 to 40% from general amount of amino acids. Amino acids present in low proportions are mostly sulfur-containing (cysteine and methionine), also threonine and lysine (Andersena, Hill, Gorbet, Brodbeck, 1998).

Small farms grow peanuts in Ukraine. At the markets one can find peanuts imported from India, Uzbekistan, and China. Such peanuts are mostly off quality because during their transportation storage terms are not always held.

It is also worth noting that Ukraine has all favorable conditions for the growth of this crop on a large scale that may make the product cheaper simultaneously raising its quality.

The main purpose of the research is to study amino acid compositions of peanuts' seeds, which may be widen in Ukraine, and determination of its biologic value.

2. MATERIALS AND METHODS

2.1. Materials

19 sorts of peanut seeds were chosen for the investigation from the collection of the Institute of Oil Plants of National Academy of Agrarian Sciences of Ukraine: Kranodarets 13, Krasnodarets 14, Krasnodarskiy 14, Krasnodarskiy 15, AR 1, AR 2, AR 3, AR 4, AR 5, AR 6, VNIIMK 14, VNIIMK 15, Pink large, Pale-pink 1, Pale-pink 2, Pale-pink 3, Dark-red, Crimson, Klinskiy.

2.2. Determination of amino acid composition

Amino acids content in peanut seeds was determined by the method of ion-exchange chromatography (Kozarenko, 1975) on automatic amino acid analyzer AAA 339M (Czech Republic).

Sample preparation for the determination of amino acids content is concluded in the following:

Scale weight (mass 0,3 g) is placed into the test-tube with ground-in stopper, where 10 cm³ of distilled water and 10 cm³ of concentrated chlorhydric acid is added. The test-tube is sealed and placed into dry-air sterilizer with the temperature 130°C for 8 hours.

The received hydrolyzate is filtered through wadding filter and washed by 3 volumes of distilled water.

The received solution is placed into porcelain bowl and evaporated on electric stove to the volume 0,5-1,0 ml.

The received sample is dissolved by the distilled water and filtered through paper filter into 50-ml test-tube, and filter is washed till the test-tube is filled up to 35-40 ml.

If pH of the received sample isn't equal 2,2±0,02, it should be corrected by means of 0,1 n of HCl or NaOH solutions to the required value.

Then quantitative determination of amino acids is held. 1 ml is taken from the the prepared sample and 1 ml of buffered solution is added from pH=2,2.

The received sample is flown through the membrane filter with the pore diameter 0,45 mkm.

50 mkl of the purified sample is taken and put into chromatographic ion-exchanging core of AAA339 analyzer.

After this the analysis is held automatically by the predetermined program for 115 minutes.

When the analysis is over, the received chromatogram is deciphered and the peak area is calculated by the method of external standard.

Tryptophan breaks-up almost completely during acid hydrolysis of protein, that is why a special analysis with the help of alkaline hydrolysis 2 n of NaOH at temperature 100°C for 16-18 hours in the presence of 5% tin chloride was made. After the corresponding neutralization by means of the mixture of citric and chlorhydric acids, hydrolyzate was analyzed on the amino acid analyzer (to prevent gelation).

2.3. Determination of the biological value of peanuts

Biological value of peanut proteins is determined through the composition and content of essential amino acids, which is determined through the comparison of amino acid composition of the researched protein by the reference scale of amino acids of hypothetic ideal protein. This method was named amino acid score. Amino acid score – is a measure of biological value of protein, and is a percentage between the part of certain essential amino acid from general amount of amino acid in the researched protein to the standard (recommended) index.

There are some methods for the calculation of amino acid score, the simplest of which is the proportion of the amount of each essential amino acid in the tested protein to the amount of the same amino acid in hypothetic protein according to amino acid scale FAO/WHO. Amino acid score of each essential amino acid was calculated by the formula (1):

$$S_i = \frac{AA_i}{AA_i^{sample}} * 100, \quad (1)$$

where S_i is amino acid score of i -essential amino acid of protein, %;

AA_i is the amount of essential amino acid of peanut protein, g/100 g of protein;

AA_i^{sample} is the amount of essential amino acid in sample protein, g/100 g of sample protein (Lipatov, Lisitsyn, Yudina, 1996).

Amino acid, whose score has the smallest index, is considered to be the one limiting biological value.

Divergence coefficient of amino acid score (DCAAS) demonstrates an average index of amino acid score surplus of essential amino acids in comparison with the smallest score level of any amino acid (excess amount of essential amino acids, which are not used for plastic demands). DCAAS is calculated by the formula (2):

$$DCAAS = \frac{\sum_{i=1}^N \Delta DAAS}{n} \quad (2)$$

Where $\Delta DAAS$ is difference of amino acid score of amino acid that is calculated by the formula (3):

$$\Delta DAAS = S_i - S_{min} \quad (3)$$

Where S_i is the surplus of amino acid score of i -essential amino acid, %;

S_{min} is minimal of all scores of essential amino acid of the researched protein in relation to the sample, %;

n is the amount of essential amino acids.

The biologic value is calculated by the formula (4):

$$BV = 100 - DCAAS \quad (4)$$

The smaller is DCAAS, the higher is the protein quality (Rogov, 2008).

3. RESULTS AND DISCUSSION

8 essential amino acids (valine, leucine, isoleucine, lysine, methionine, phenylalanine, tryptophan, threonine) and 10 replaceable amino acids (asparaginic acid, cystine, serine, tyrosine, arginine, glutamic acid, glycine, proline, histidine and alanine) were identified and qualitatively determined (Table1).

Table 1. Contents of amino acids in the researched samples of peanuts, g/100 g of protein

Amino acids	Krasnodarets 13	Krasnodarets 14	Krasnodarskiy 14	Krasnodarskiy 15	AR 1	AR 2	AR 3	AR 4	AR 5	AR 6
Essential amino acids										
Valine	2 ^b	4 ^{9b}	3 ^{2b}	2 ^{9bc}	5 ^{8a}	5 ^{9a}	4 ^{2b}	6 ^{4a}	3 ^{2bc}	4 ^{9b}
Leucine	6 ^{bc}	5 ^{3b}	6 ^{5ab}	6 ^{1ab}	8 ^{9a}	5 ^{4b}	4 ^{2c}	5 ^{8b}	5 ^{4b}	9 ^{3a}
Isoleucine	9 ^b	2 ^{5b}	1 ^{5c}	3 ^{0ab}	4 ^{4a}	1 ^{2c}	2 ^{7b}	2 ^{0bc}	1 ^{1c}	4 ^{9a}
Lysine	3 ^a	2 ^{5bc}	1 ^{3c}	3 ^{0bc}	3 ^{5b}	1 ^{6c}	1 ^{5c}	4 ^{6a}	2 ^{7bc}	2 ^{2c}
Methionine	8 ^{bc}	1 ^{4ab}	1 ^{0b}	1 ^{5ab}	0 ^{6c}	0 ^{8bc}	1 ^{1b}	1 ^{8ab}	1 ^{1b}	1 ^{3b}
Phenylalanine	2 ^b	3 ^{2c}	3 ^{9b}	4 ^{4b}	6 ^{9a}	3 ^{2c}	3 ^{1c}	5 ^{8a}	4 ^{8b}	4 ^{7b}
Tryptophan	1 ^a	1 ^{0a}	1 ^{0a}	1 ^{0a}	1 ^{0a}	1 ^{0a}	1 ^{0a}	1 ^{0a}	1 ^{0a}	1 ^{0a}
Threonine	8 ^a	4 ^{6a}	3 ^{5b}	1 ^{7c}	2 ^{4bc}	2 ^{8bc}	3 ^{0bc}	2 ^{9bc}	3 ^{2b}	2 ^{2c}
Total	27,9	25,4	21,9	23,6	33,5	21,9	20,8	30,3	22,5	30,5
Nonessential amino acids										
Asparaginic acid	9,1 ^{bc}	9,3 ^{bc}	12,5 ^a	10,2 ^{ab}	8,4 ^{bc}	9,6 ^b	13,0 ^a	7,3 ^c	10,5 ^{ab}	7,7 ^c
Serine	6,4 ^a	5,8 ^a	5,2 ^{ab}	5,1 ^{ab}	3,9 ^{bc}	5,9 ^a	4,0 ^{bc}	2,9 ^c	4,7 ^b	2,8 ^c
Glutamic acid	16,7 ^{bc}	14,4 ^c	21,0 ^a	19,0 ^{ab}	17,8 ^b	18,9 ^b	19,2 ^{ab}	15,7 ^c	20,9 ^a	16,4 ^{bc}
Proline	6,9 ^{bc}	7,1 ^{bc}	9,5 ^{ab}	8,0 ^b	4 ^{2c}	11,5 ^a	10,9 ^a	6,6 ^{bc}	8,9 ^b	9,9 ^{ab}
Glycine	9,1 ^a	7,1 ^a	6,5 ^{ab}	5,1 ^{bc}	7,0 ^a	6,8 ^{ab}	7,2 ^a	6,3 ^b	6,4 ^b	4,4 ^c
Alanine	6,4 ^a	4,9 ^b	4,5 ^{bc}	3,9 ^c	4,9 ^b	3,9 ^c	7,6 ^a	6,6 ^a	4,3 ^{bc}	3,8 ^c
Histidine	2,3 ^b	1,8 ^c	2,6 ^b	2,1 ^{bc}	3,9 ^b	4,8 ^a	1,5 ^c	4,6 ^a	2,7 ^b	2,8 ^{bc}
Arginine	10,9 ^b	17,7 ^a	9,4 ^{bc}	15,0 ^a	9,5 ^{bc}	11,9 ^b	11,2 ^b	13,3 ^{ab}	10,9 ^b	15,7 ^a
Cystine	1,4 ^{bc}	2,5 ^{ab}	2,7 ^a	1,1 ^c	1,0 ^c	1,2 ^{bc}	1,0 ^c	1,1 ^c	1,2 ^{bc}	1,3 ^b
Tyrosine	2,6 ^b	2,8 ^b	3,5 ^{ab}	3,2 ^b	4,0 ^a	2,4 ^{bc}	2,7 ^b	4,6 ^a	4,3 ^a	4,4 ^a
Total	71,8	73,4	77,4	72,7	64,6	76,9	78,3	69,0	74,8	69,2

Table 1 (continued)

Amino acids	VNIIMK 14	VNIIMK 15	Pink large	Pale-pink 1	Pale-pink 2	Pale-pink 3	Dark-red	Crimson	Klinskiy
Essential amino acids									
Valine	3,1 ^{bc}	4,8 ^b	1,9 ^c	3,7 ^b	5,1 ^a	3,0 ^b	3,5 ^b	4,9 ^b	5,4 ^a
Leucine	3,9 ^{bc}	5,4 ^b	7,4 ^a	4,3 ^c	5,1 ^b	4,4 ^{bc}	5,1 ^b	5,7 ^b	4,3 ^{bc}
Isoleucine	2,6 ^b	2,9 ^{ab}	3,2 ^a	2,2 ^b	2,3 ^b	2,1 ^b	1,5 ^c	2,6 ^b	2,7 ^b
Lysine	3,9 ^a	3,9 ^b	3,9 ^b	2,7 ^{bc}	2,3 ^c	3,4 ^b	1,8 ^c	2,3 ^c	2,7 ^{bc}
Methionine	0,6 ^c	0,9 ^{bc}	2,4 ^a	0,5 ^c	1,4 ^{ab}	0,7 ^c	0,8 ^{bc}	1,4 ^{ab}	1,6 ^{ab}
Phenylalanine	3,5 ^c	3,9 ^{bc}	4,4 ^b	2,7 ^c	2,8 ^c	3,7 ^{bc}	3,8 ^{bc}	5,4 ^a	3,8 ^{bc}
Tryptophan	1,0 ^a	1,0 ^a	1,0 ^a	1,0 ^a	1,0 ^a	1,0 ^a	1,1 ^a	1,0 ^a	1,0 ^a
Threonine	2,0 ^c	4,8 ^a	1,9 ^c	3,7 ^{ab}	2,8 ^{bc}	3,0 ^{bc}	3,5 ^b	1,4 ^c	4,3 ^a
Total	22,6	27,6	26,1	20,8	22,8	21,3	21,1	24,7	25,8
Nonessential amino acids									
Asparaginic acid	9,1 ^{bc}	9,3 ^{bc}	12,5 ^a	10,2 ^{ab}	8,4 ^{bc}	9,6 ^b	13,0 ^a	7,3 ^c	10,5 ^{ab}
Serine	6,4 ^a	5,8 ^a	5,2 ^{ab}	5,1 ^{ab}	3,9 ^{bc}	5,9 ^a	4,0 ^{bc}	2,9 ^c	4,7 ^b
Glutamic acid	16,7 ^{bc}	14,4 ^c	21,0 ^a	19,0 ^{ab}	17,8 ^b	18,9 ^b	19,2 ^{ab}	15,7 ^c	20,9 ^a
Proline	6,9 ^{bc}	7,1 ^{bc}	9,5 ^{ab}	8,0 ^b	4,2 ^c	11,5 ^a	10,9 ^a	6,6 ^{bc}	8,9 ^b
Glycine	9,1 ^a	7,1 ^a	6,5 ^{ab}	5,1 ^{bc}	7,0 ^a	6,8 ^{ab}	7,2 ^a	6,3 ^b	6,4 ^b
Alanine	6,4 ^a	4,9 ^b	4,5 ^{bc}	3,9 ^c	4,9 ^b	3,9 ^c	7,6 ^a	6,6 ^a	4,3 ^{bc}
Histidine	2,3 ^b	1,8 ^c	2,6 ^b	2,1 ^{bc}	3,9 ^{ab}	4,8 ^a	1,5 ^c	4,6 ^a	2,7 ^b
Arginine	10,9 ^b	17,7 ^a	9,4 ^{bc}	15,0 ^a	9,5 ^{bc}	11,9 ^b	11,2 ^b	13,3 ^{ab}	10,9 ^b
Cystine	1,4 ^{bc}	2,5 ^{ab}	2,7 ^a	1,1 ^c	1,0 ^c	1,2 ^{bc}	1,0 ^c	1,1 ^c	1,2 ^{bc}
Tyrosine	2,6 ^b	2,8 ^b	3,5 ^{ab}	3,2 ^b	4,0 ^a	2,4 ^{bc}	2,7 ^b	4,6 ^a	4,3 ^a
Total	71,8	73,4	77,4	72,7	64,6	76,9	78,3	69,0	74,8

Values in the lines with different letters (a-c) are significantly different ($p < 0.05$).

Analysis of Table 1 allows us make a conclusion that AR 1, AR 6 and AR 4 peanut sorts contain the largest amount of essential amino acids.

As for the content of nonessential amino acids the sorts AR 3 and Pale-pink 1, Krasnodarskiy 14, AR 2 are the leaders. A little smaller amount of nonessential amino acids contain the sorts Dark-red and VNIIMK 14.

Glutamic acid takes largest part among nonessential amino acids of peanut protein. Its content fluctuates from 21,0 to 14,4 g / 100 g of protein. Glutamic acid stimulates memory and brainwork, participates in protein synthesis, increases endurance, and neutralizes toxic compounds in the organism. Amino acids also contain a lot

of peanut protein arginine. Arginine is important for muscles metabolism. It is used for the treatment of atherosclerosis, hypertensive disease, hepatocirrhosis, stimulates pancreas activity. It produces insulin, is the source of nitrogen, stimulates mental system, prevents weariness, checks the growth of tumors, reduces the fat level in the body, helps remove ammonia from the organism, participates in the creation of ornithine and creatine. The largest amount of arginine is found in Krasnodarets 14, VNIIMK 14, AR 6 and Krasnodarskiy 15.

Peanut protein contains from 4,2 to 11,9 g / 100 g of protein proline. Proline strengthens joints and ligaments, participates in energy production, helps cure wounds. The samples AR 2, Klinskiy and AR 4 have the largest amount of histidine among all the investigated samples. Histidine stimulates blood circulation, regulates photosynthesis of folic and nucleic acids, participates in the creation of red and white blood haematocytes, reduces anemia acuity, supports auditory nerve, takes part in protein synthesis.

Alanine promotes recovery after traumas, regulates blood Saccharum, participates in energy-formation, and helps store glycogen by muscles and liver. The AR 3, AR 4, Krasnodarets13 contain the largest amount of alanine.

Asparaginic acid participates in metabolism of nervous system, in amino acids synthesis in liver and synthesizes DNA and RNA. Amount of asparaginic acid is maximum in AR 3 sort, particularly 13,0 g / 100 g of protein.

Glycine is antidepressant. In the average its amount in the researched samples fluctuated from 4,4 g / 100 g of protein (AR 6 sort) to 9,1 g / 100 g of protein (Krasnodarets13 sort). Glycine increases brain activity, reduces gastric acidity.

Small amount of serine was found. Its amount fluctuated from the largest 6,4 g / 100 g of protein in Krasnodarets 13 to the smallest amount 2,8 g / 100 g of protein in AR 6 sort. Serine strengthens immune system; it is required for fat and fatty acids metabolism, takes part in the biosynthesis of glycine, cystine and tryptophane.

In Table 2 you can see calculations of amino acid score that permits getting data about every amino acid, discrepancy coefficient of amino acid score (DCAAS) and biologic value (BV) of each of the researched sorts of peanut. However, both the total amount of sulfur-containing amino acids was taken into account because methionine turns to cystine in the organism, and the total of aromatic amino acids because phenylalanine turns to tyrosine.

The calculated amino acid score demonstrates that proteins of all sorts of peanut are valuable resource of phenylalanine and tyrosine. Score by these amino acids approaches "an ideal protein" in AR 2, AR 3 and Pale-pink 1 sorts. In other sorts of peanut they even exceed "an ideal protein", in AR 1 sort, for example, about 2 times. Tyrosine is antidepressant that promotes functioning of adrenal gland and thyroid gland. Phenylalanine stimulates CNS, improves memory and attention, increases working capacity, and reduces appetite.

Amino acid score corresponds "an ideal protein" by tryptophan in all sorts of peanut and fluctuates from 100 to 105 %. It is proved that tryptophan regulates function of immune and nervous systems, improves sleep, stimulates growth of hair, improves digestion.

Valine is necessary for the organism to support the required level of nitrogen exchange. It metabolizes to muscular tissue, stimulates brain activity. Amino acid score of the given amino acid exceeds "ideal protein" in AR 1, AR 2, AR 4, Pale-pink 2 and Klinskiy sorts. In the sorts Krasnodarets 14, AR 6, VNIIMK 15, and Crimson this amino acid is limiting. Its amino acid score equals 39 %.

Leucine is a source of energy, it promotes muscle and bones rehabilitation, reduces higher level of sugar in blood during diabetes. The calculated Amino acid score of leucine showed that the content of this amino acid is the smallest in the sorts AR 3, Pale-pink 1, Pale-pink 3, Klinskiy (amino acid score fluctuates from 60 to 62,1 %). In the sorts AR 1, AR 6 and Pink large amino acid score of the given amino acid exceeds "ideal protein".

Isoleucine regulates the level of sugar in blood, participates in the synthesis of haemoglobin, increases staying power of the organism, participates in the synthesis of metabolism in muscles, and splits cholesterol. The largest score is registered in the sorts AR 1 and AR 6, the smallest – in the sorts Krasnodarskiy 14, AR 2, AR 5, Dark-red. Amino acid score of isoleucine in the sorts AR 4 and AR 5 is limiting.

Lysine is necessary for the growth of the bone tissue, support of female function. It supports nitrogen exchange in the body, possesses antiviral action, and stimulates brain activity. The largest score by lysine is noticed in the sorts Krasnodarets 13 and VNIIMK 14, the smallest – in the sorts Krasnodarets 14, Krasnodarskiy 14, AR 2, AR 3, AR 5, AR 6, Pale-pink 1, Pale-pink 2, Dark-red, Crimson, Klinskiy. Amino acid score of lysine in the sorts

Krasnodarets 14, Krasnodarskiy 14, AR 2, AR 3, AR 6, VNIIMK 15, Pale-pink 2, Dark-red and Klinskiy is limiting.

Table 2. Evaluation of protein quality (according to amino acid score and DCAAS) and biologic value of peanut protein

Nonessential amino acid	Sample FAO/WHO	Krasnodarets 13		Krasnodarets 14		Krasnodarskiy 14		Krasnodarskiy 15		AR 1	
		S	ΔDAAS	S	ΔDAAS	S	ΔDAAS	S	ΔDAAS	S	ΔDAAS
Valine	5,0	83,2	21,8	97,8	52	64	41	59	16	115	68,7
Leucine	7,0	65,7	4,3	76,1	31	93	70	87	44	127,1	80,8
Isoleucine	4,0	72,2	10,8	62,25	17	37,5	14,5	75	32	110	63,7
Lysine	5,5	96,3	34,8	45,3*	0	23*	0	54	11	63	16,7
Methionine+cystine	3,5	61,4*	0	111,4	66	105,7	82,7	73,4	30,4	46,3*	0
Phenilalanine+tyrosine	6,0	113,5	52,1	100,7	55	123	100	126	83	183,3	137
Tryptophan	1,0	105	43,6	102	57	100	77	100	57	102	55,7
Threonine	4,0	118,7	57,3	115,5	70	87	64	43*	0	61	14,7
ΣΔDAAS			224,7		348		449,2		273,4		437,3
DCAAS			28,0		43,5		56,1		34,2		54,6
BV			72		56,5		43,9		65,8		45,4
Nonessential amino acid	Sample FAO/WHO	AR 2		AR 3		AR 4		AR 5		AR 6	
		S	ΔDAAS	S	ΔDAAS	S	ΔDAAS	S	ΔDAAS	S	ΔDAAS
Valine	5,0	119,6	91,6	84	57	127	77	63	37	99	60
Leucine	7,0	77,1	49,1	60	33	82	32	76,8	50,8	133	94
Isoleucine	4,0	29	1	66	39	50*	0	26*	0	121	82
Lysine	5,5	28*	0	27*	0	82	32	48	22	39*	0
Methionine+cystine	3,5	57,7	29,7	62	35	80,8	30,8	65,1	39,1	73,7	34,7
Phenilalanine+tyrosine	6,0	93	65	95	68	173	123	150	124	150	111
Tryptophan	1,0	102	74	103	76	104	54	100	74	101	62
Threonine	4,0	69	41	76	49	71	21	79	53	54	15
ΣΔDAAS			351,4		357		369,8		399,9		458,7
DCAAS			43,9		44,6		46,2		49,9		57,3
BV			56,1		55,4		53,8		50,1		42,7

Table 2 (continued)

Nonessential amino acid	Sample	VNIIMK 14		VNIIMK 15		Pink large		Pale-pink 1		Pale-pink 2	
		S	ΔDAAS	S	ΔDAAS	S	ΔDAAS	S	ΔDAAS	S	ΔDAAS
Valine	5,0	62	13,4	96	26	39*	0	74	28,9	102	61
Leucine	7,0	69,28	20,7	77	7	105	66	61	15,9	72	31
Isoleucine	4,0	64,3	15,7	73	3	79	40	54	8,9	56	15
Lysine	5,5	90,7	42,1	70*	0	72	33	49,0	3,9	41*	0
Methionine+cystine	3,5	48,57*	0	95,4	25,4	98	59	45,1*	0	130,2	89,2
Phenylalanine+tyrosine	6,0	110	61,4	121	51	145	106	75	29,9	125	84
Tryptophan	1,0	103	54,4	104	34	102	63	103	57,9	103	62
Threonine	4,0	50	1,43	121	51	49	10	92	46,9	70	29
ΣΔDAAS			209,1		197,4		377		192,3		371,2
DCAAS			26,1		24,7		47,1		24,0		46,4
BV			73,9		75,3		52,9		76		53,6
Nonessential amino acid	Sample	Pale-pink 3		Dark-red		Crimson		Klinskiy			
		S	ΔDAAS	S	ΔDAAS	S	ΔDAAS	S	ΔDAAS		
Valine	5,0	60	10	70	38	99	64	108	59		
Leucine	7,0	62,1	12,1	72	40	80	45	61	12		
Isoleucine	4,0	52,5	2,5	37	5	64	29	67	18		
Lysine	5,5	61	11	32*	0	41	6	49*	0		
Methionine+cystine	3,5	50*	0	52,2	20,2	71,14	7	123	74		
Phenylalanine+tyrosine	6,0	118	68	117	85	165	130	108	59		
Tryptophan	1,0	104	54	105	73	103	68	103	54		
Threonine	4,0	75	25	87	55	35*	0	108	59		
ΣΔDAAS			182,6		316,2		349		335		
DCAAS			22,8		39,5		43,6		41,9		
BV			77,2		60,5		56,4		58,1		

* – the first limiting acid

S – amino acid score, %

ΔDAAS – divergence of amino acid score, %

BV – biologic value

It is known that methionine improves digestion, helps to process fat, splits cholesterol, and prevents loss of hair. Cystine in its turn activates immune system, improves brain activity, and acts as an antioxidant. Amino acid score of methionine and cystine in the researched sorts of peanut fluctuates from 130,2 % (Pale-pink 2) to 45,1 % (Pale-pink 1). The largest amino acid score of methionine and cystine had the sorts Pale-pink 2, Klinskiy, Krasnodarets 14, Krasnodarskiy 14, which exceeds "an ideal protein". The limiting amino acid score was noticed in the following samples: Krasnodarets 13, AR 1, VNIIMK 14, Pale-pink 1, Pale-pink 3, Dark-red.

Threonine is one of the essential amino acids, which activates immune system, promotes tissue coalescence, assists in nutritive protein uptake. The calculated amino acid score showed that the amount of this amino acid is limiting in the sorts Krasnodarskiy 15 and Crimson. In the sorts Krasnodarets 13, Krasnodarets 14, VNIIMK 15 and Klinskiy amino acid score of the given amino acid exceeds "an ideal protein".

So, the peanut sort Pale-pink 3 has the highest biologic value of protein – 77,2 %. This sort is the most balanced by its amino acid composition in comparison with the other sorts. The peanut sorts Pale-pink 1, VNIIMK 15, VNIIMK 14 and Krasnodarets 13 have smaller biologic value – only 42,7 %. A large discrepancy of amino acid score by some amino acids explains such low index of biologic value of proteins in these sorts, in particular in the sort AR 6 the first limiting acid lysine constitutes 39 %, amino acid score of phenylalanine and tyrosine equals 150 %. Krasnodarskiy 14 is characterized by low content of lysine and simultaneously high level of phenylalanine and tyrosine. AR 1 sort contains the smallest amount of sulfur-containing amino acids (methionine+cystine) – 46,3 %, while phenylalanine and tyrosine constitute 183,3 %.

In modern conditions it is reasonable to use computer-aided design to formulate food products composition on the basis of the ingredients able to compensate formation of amino acid composition of total protein. When the components are properly chosen, it is possible to compose the outgoing mixture composition with optimal content of protein on the basis of plant raw material.

4. CONCLUSIONS

The amino acid score, the divergence coefficient of amino acid score and biologic value of 19 sorts of peanut are calculated.

Glutamic acid prevails in amino acid composition of peanut. Also peanuts contain much arginine. Peanut protein contains the smallest amount of methionine and cystine.

The researched sorts of peanut greatly differ (3-4 times) in the content of some amino acids, particularly isoleucine, lysine and threonine. Such difference in amino acid composition of the researched peanut sorts can be explained by varietal peculiarities of their biochemical composition. Note that peanut Krasnodarets 13 contain more lysine and threonine comparing with the other sorts. As may be supposed, this sort of peanut was deliberately selected according to the bio-fortification principles for the achievement of high level of the given amino acids. The strategy of bio-fortification means creation of plants with the increased content of the determined elements and compounds, both the ones absorbed from the soil and which are synthesized in the plant. This strategy realization is based on hybridization, radiation and chemical mutagenesis, selection, and methods of molecular genetics. This fact explains high content of isoleucine in the sort AR 6, lysine in the sort VNIIMK 14, threonine in the sorts Krasnodarets 14, VNIIMK 15, and Klinskiy.

Biologic value of peanut proteins of such sorts as Pale-pink 3, Pale-pink 1, VNIIMK 15, VNIIMK 14 and Krasnodarets 13 has the highest index and equals 77,2–72% in comparison with the other researched sorts. It is known that biologic value of beef protein equals 87%, pork protein constitutes 84% (Chernikov, 1986).

The represented data demonstrate that biologic value of proteins in the mentioned peanut sorts is close to animal proteins. Modeling of the receipt of the combined plant raw materials for functional products will allow partially change expensive animal protein to the identical by biologic value plant protein, which is 2-3 times cheaper by the production cost.

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