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PROTEIN DENSITY AND QUALITY OF KORO KRATOK (*Phaseolus lunatus L.* Sweet) AND KACANG TUNGGAK (*Vigna unguiculata (L.)* Walp)

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INTRODUCTION

Proteins are macronutrient, plays important roles in human health. It is essential to life because it is a vital par of the nucleus and protoplasm of every cell. The outer layers of skin, the hair, and the nails consist of almost entirely of an insoluble protein called keratin. The most active and abundant tissues of the body – the muscles and glandular organs- are high in protein content. Lean muscles, heart, and liver contain 17-21 percent protein. Connective tissues consists mainly of protein. Blood carries the important iron-containing protein hemoglobin in red blood cells. Therefore, the 50 gram daily requirement is a must to be fulfilled.

Protein are larger and more complex molecules than those of either fats or carbohydrate. The large molecules of protein made up of great number of amino acids. The number of difference amino acids in the molecules of certain protein varies from 8 to 18 according to the size and complexity of the molecules of different protein. The number and composition of essential amino acids of protein determine utility of the protein for human health.

Human obtain proteins from animal and plant food sources. Nuts food group is plant origin of food protein since it contain high protein, range from 17-30 percent. Koro kratok (*Phaseolus lunatus L.* Sweet) and kacang tunggak (*Vigna unguiculata (L.)* Walp) (Kasno and Achmad, 1988) are kinds of nut that have high protein content. However, its high amount of protein does not explain utilizing of the nut protein for human health. Intake of 50 gram protein does not explain the quality of protein. Therefore, it is important to evaluate the quality nut protein.

METHODS

This pure experimental research consists of four steps: 1) sampel preparation- koro kratok dan kacang tunggak were clean from dirty, 2) grinding the bean became nut powder, 3) protein content analysis, and 4) evaluation of protein density dan protein quality of the bean protein.

Protein Content Analysis

Protein content was analyzed using Kjedahl method (AOAC,2001; Walker, 2007). One gram nut powder was poured into the Kjeldahl flask, and then add 7 g of K_2SO_4, 0,8 g of $CuSO_4$, and 12 mL tough of H_2SO_4. The solution in the flask was heated in the smoked cupboard for 1 hour, and then was cooling off for 10-20 minutes. After cold, addition of water until 80 mL. Furthermore, the solution was added by 50 mL NaOH 40% w/w, then was destilated to get 150 mL. The destilat was poured to Erlenmeyer with 30 mL H_3BO_3 1% w/v that given mix indicator. The destilate was titrated by standard solution – HCl 0.1 M until the clear violate color emerge.

Protein Quality Evaluation (Tejasari,2005)

Protein quality was evaluated based on the Amino Acid Score (AAS) parameter using FAO/WHO amino acid pattern reference. There are eight essential amino acids (EAA)– isoleusin (Ile), lysine (Lys), methionine (Met) + cystine (Cys), Phenilalanin (Phe) + Tyrosine (Tyr), tryptophan (Tryp), threonine (Tre), and valin (Val). All these EAAs should be available in certain amount in order that protein be functioned, as stated by FAO/WHO. The EAAs pattern of FAO/WHO reference was used for comparing of the EAAs of the nuts. The Amino Acid Score (AAS) is percentage ratio between the nuts EAAs and the reference EAAS. This parameter explains the biological value of protein that determining of protein quality.

RESULT AND DISCUSSIONS

Koro kratok and kacang tunggak (see Figure 1) are two kinds of nuts that increasingly used as food protein ingredient (Haliza dkk., 2007) because of its high protein content. However, it is important to know the quality of the protein in order to make sure its effect on health.

The principle use \s for protein in the body are as follows : 1) for building new tissues, 2) for upkeep of tissues, 3) as regulatory substances for internal waste and acid balanced, 4) as a precursor for enzyme, antibodies, some hormones, and one of the vitamin B, 5) for milk formation, and 6) for energy. As the vital function of protein, an appropriate intake level and balance of EAA and nonessential

amino acids of protein is required to support and maintain the adequate functioning cells and organs.
The protein content is essential to maintain nitrogen balance in human body. Negative nitrogen balance is inevitably occurs when the protein intake is reduced below the minimum required for maintenance of body tissue or the minimum protein requirement. Meanwhile, the protein quality that can be indicated by score of amino acid explain the completeness of the number and kinds of essential amino acids needed for health. Certain number, quantity, kinds, and sequence of amino acids is needed in oder to protein to be function.

Figure 1: Koro Kratok, Kacang Tunggak and its powder

Protein Density

Protein density is refer to the percentage of food protein content toward the protein recommendated daily allowances (RDA). Koro kratok and kacang tunggak contributes by 35.6 and 39.8 percent of RDA, respectively.These figure showed that this nut have quiet high protein content.
Although, the protein is high in amount, however it does not tell about number, kinds, or amount of amino acids. Whereas, amino acids are needed for certain biological function of protein, such as lysine, tryptophan, methionine, and cystine are needed for growth and maintenance. Zein is low in lysine and tryptophan, gliadin low in lysine. Therefor, these protein play in maintenance roles, not for growth. The density of these two nuts are lower than the protein density of green and kidney bean (see Figure 2).

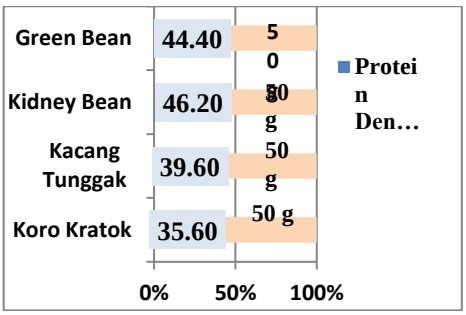

Figure 2: Protein density of Koro Kratok and Kacang Tunggak beans compare to other bean

Protein Quality

Protein quality could be evaluated using Amino Acids Score (AAS) parameter. The value of AAS indicated the fulfillment level of every EAAs toward the amount of every EAA standard. The highest the score, the best of the protein quality. Amino acid with the lowest value of the AAS limits the protein function.
The evaluation showed that Koro Kratok very good in Phenilalanine and tyrosine, and treonine, indicating by its AAS values; 130 and 100 (above and 100), good in tryptophan and valine, and quiet good in iso leucine, leucine, and lysine, and not good in methionine and cystine.
The essential amino acids data evaluation (see Table 1) showed that Koro Kratok very good in Phenilalanine and tyrosine, and treonine, indicating by its AAS 130 and 100 (above and 100), good in tryptophan and valine, and quiet good in iso leucine, leucine, and lysine, but not good in methionine and cystine.
The essential amino acids data evaluation (see Table 1) showed that Kacang Tunggak is good in lysine, phenylalanine and tyrosine, and tryptophan, indicating by its AAS values above 100. This bean has protein quality quiet good in leucine, isoleusine, and valine , however low in methionine and cystine.
Protein analysis showed that the both beans, Koro Kratok and Kacang Tunggak, have high protein content. However, amino acids data analysis showed that in a whole, the protein quality of both nuts are low, indicating by its AAS values as follows : 23 and 45, respectively, with the sane limiting amino acids of the protein of the bean is methionine and cystine. It means that these two bean is not food sources of methionine and cystine. Therefore, as food ingredient, it is important to add other kinds of nut that high in methionine and cystine to increase the quality of the protein.
Methionine, the essential sulfur amino acids, has sparing effect of dietary cystine. The estimates of the methionine-sparing effects of dietary cystine in human vary widely, from about 16-89 % of the total methionine requirements, relative to the methionine need determined with a cystine-free diet (Bodwell and Erdman, 1988).

Table 1. Evaluation of nuts protein quality indicating by Amino Acid Score (AAS)

Bean or Nuts	Protein Content	Essential Amino Acid Content per 100 g bdd								SAA value (counting)
		Ile	Leu	Lis	Met + Cys	Phe+Tyr	Treo	Trypt	Val	
Koro Kratok	12,5 g	314	554	395	101	979	500	100	500	SAA =23 Amino acid Restriction Methionine-Cystine (m-s)
	17,8 g	447	789	562	143	1394	712	142	712	
	1 g	Essential Amino Acid Content per g protein								
		25	44	32	8	78	40	8	40	
	SAA	*62,5*	*62,85*	*58,18*	*22,86*	*130*	*100*	*80*	*80*	
Kacang Tunggak	24,4 g	764	1466	1455	383	1840	831	302	815	SAA = 45 Amino acid Restriction Methionine-Cystine (m-s)
	19,88 g	622	1194	1186	312	1499	677	246	664	
	1 g	Essential Amino Acid Content per g protein								
		31,3	60	59,7	15,7	75,4	34,1	12,4	33,4	
	SAA	*78,25*	*85,7*	*108,5*	*44,86*	*125,7*	*85,25*	*124*	*66,8*	
Amino Acid Pattern FAO/WHO	(mg EAA/ g Protein)	40	70	55	35	60	40	10	50	

CONCLUSSION

The protein content of Koro Kratok and Kacang Tunggak are quiet high, that is 17.8 and 19.8 g per 100 gram of its edible portion.

The protein density of the protein are low, that is 35.6 and 39.8 percent of RDA, respectively.

The quality of protein of Koro Kratok and Kacang Tunggak is low, indicating by its low value of Amino Acid Score (AAS) that is 23 and 45, respectively.

The limiting amino acids is methionine + cystine because it limits the function of the protein it composed.

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