CHEMICAL PROPERTIES OF PROTEIN IN COTTON SEED KERNELS

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ABSTRACT

Fuzzy cottonseed is composed of one third of hulls and two third of cottonseed kernels. Linters and hulls can be used in various purposes in industry and livestock feed. Cottonseed kernels contain quite high protein (36.6 %) and fat (32.5 %). The comparison of albumin, globulin, glutelin and prolamin of protein in cottonseed kernels are 30.7 : 60.3 : 0.5 : 8.6. Protein of cottonseed kernels is easy to dissolve and to be digested. The solution of protein in 0.1 N NaOH reaches 92.9 %, while in vitro digestibility with pepsin 77.8 - 85.9 %. Based on FAO pattern (1973), the protein of cottonseed lacks some essential amino acid i.e. : sulfuric amino acid, aromatic amino acid, leucine and isoleucine. The flour of cottonseed kernels is quite good for composing mixed feed together with soybean flour because their amino acid contents can complement each other.

INTRODUCTION

Together with the development program for IKR (Cotton Intensification for Small Holders) as one of the efforts to decrease import for cotton fibers as textile materials, in cottonseed processing locations (ginnery), a kind of waste of cottonseed will pile up. If this cottonseed waste isn't immediately used, it will be a source of a contagious cotton pest, called Pectinophora. At present, cottonseed waste in Indonesia hasn't been used maximally. The amount of cottonseed will increase every year in accord with enlargment of developing areas and rising productivity. Therefore, it needs an effort to use the cottonseed waste in order to increase farmers income as IKR members.

Fuzzy cottonseed is composed of one third of hulls and two third of cottonseed kernels. Linters can be used for various purposes for example as a raw material of pulp for paper, absorbent cotton for medical use, wall paper , carpets etc. While hulls can be used as a livestock feed, fertilizer and also for pulps (Cherry, 1985). Cottonseed kernels have a quite high protein and fat content so that they are a potential materialfor making oil, material for food and livestock feed.

Cottonseed oil has been used as refined oil abroad, while cottonseed flour is used for food ingredients to increase its protein. There is a kind of food ingredient in South America (Guatemala and Columbia) that is called Incaparina. This incaparina contains fat-free flour of cottonseed (20 - 38 %), corn flour, soybean flour (Winarno, 1984). A fat-free flour of cottonseed can be used to making

cakes,breads, crackers etc. (Gardner et al., 1976). As livestock feed, cottonseed flour can either be fed to various livestock, ruminants or non rumainants (Tangenjaya, 1987).

The gossypol content in cottonseed is one of the obstacles in using cottonseed. The gossypol can reduce amino acids lysine, can compose Ferrum in erythrocytes and change the oil colour to become dark)Berardi and Godblatt, 1980; Gardner et al, 1976). To reduce gossypol toxicity in cottonseed can be done by changing free gossypol to be bound gossypol. The bound gossypol will be less active, can not be absorbed by the body and can be wasted together with faeces. Responsible methods are to make an effort to break gossypol gland when processing or adding Ferum compound ($FeSO_4$).

Chemical composition

Cottonseed flour contains 36.6 % of protein,(a little higher than soybean and winged bean) and 32.5 % of fat content (Table 1).

Table 1. Chemical composition of cotton seed, soybean, peanut and winged bean

	Cottonseed	Soybean	Peanut	Winged bean[3)]
Protein (%)	36.6	34.1	26.0	36.5
Fat (%)	32.5	17.7	47.5	18.0
Ash (%)	5.3	4.7	2.3	4.1
Moisture(%)	10.0	10.0	5.6	3.4

1) Saroso and Damardjati (1988)
2) Okezie and Martin (1980)
3) NAS (1981)

With the high protein content, the flour of cottonseed can be used as a substitution of soybean flour in mixed feed up to a certain amount. The soybean flour substitution to flour cottonseed kernels will increase fat content in ration mixed feed therefore the oil content in cottonseed needs to be reduced firstly.

Cottonseed is very good for a complement in mixed feed to produce milk or it can help to gain weight. It is related to protein properties in cottonseed. Protein protection against bacteria invasion in ruminants enable protein content to get higher for milk or meat production (Tangenjaya, 1987).

Cottonseed kernels also contain adequate minerals.The mineral content in the cottonseed are mainly Calcium and Phosphor, so it is good for mixed feed in growing phase (NRC, 1984).

Composition of protein fractions

Based on its solution, protein is devided into few clusters i.e. : albumin, globulin. glutelin and prolamin (Winarno. 1984). The comparison between the four clusters of the protein fraction in cottonseed kernels are 30.7 : 60.3 : 0.5 : 8.6 resembles soybean and peanut (Table 2).

Table 2. Composition of fractions in cotton seed, soybean, peanut and rice

	Cottonseed[1])	Soybean[2])	Peanut[3])	Rice[3])
Albumin	30.7	11	22	2.8
Globulin	60.3	74	67	7.7
Glutelin	0.5	5	2	63.6
Prolamin	8.6	10	8	1.2

1) Saroso and Damardjati (1988)
2) Kapoor and Gupta (1977)
3) Poulter (1981)
4) Purwani (1987)

Besides a protein content that is quite high, the composition of protein in cottonseed kernels obviously resembles soybean flour or peanut flour. With the resemblance to protein fractions composition with soybaen or peanut, it enables cottonseed flour to be a substitution of soybean or peanut flour as mixed feed composer.

The resemblance to protein fractions composition in the cottonseed, it shows similar physical property or chemical material which is prepared. Cottonseed protein is mainly composed of protein from albumin and glutelin cluster, it is equal to protein of Leguminoceae grain families.

Solution and in vitro digestibility

Protein of cottonseed kernel is easy to dissolve and to be digested. The solution of protein in 0.1 N NaOH reaches 92.9 %, while in vitro digestibility with pepsin 77.8 - 85.9 % (Table 3).

Nitrogen solution in the cottonseed kernels are quite high (92.9 %) compared with nitrogen solution in rice (62.4-63.6 %), because the protein of rice in mainly composed of glutelin fractions which are kept as protein bodies in seed endosperm. The high solution and protein digestibility in cottonseed kernels cause protein easily to be prepared, which they are used in the body. It is related to its composition of protein fractions. The protein of cottonseed kernels are mainly composed of albumin and globulin. Both the albumin and globulin are in seed aleuron layer, so that they are easily dissolved in protein solution or pepsin enzyme.

Table 3. Solution and in vitro protein digestibility in cotton seed, pigeon pea, peanut and rice

	Cottonseed[1])	Pigeon pea[2])	Peanut[3])	Rice[4])
In vitro digestibility	77.8 - 85.9	59.0 - 85.8	-	74.5 - 79.3
Solution	92.9	-	93.9	62.4 - 63.6

1) Saroso and Damardjati (1988)
2) Yadav (1978)
3) Santoso et al (1985)
4) Purwani (1987)

Amino acids content

Amino acids content in the protein determines protein qualities. The qualities can be stated bases on amino acids score and protein efficiency ratio (PER).

Protein of grains are commonly containing aspartic acid, glutamic acid and arginine in a great amount, but they are lack of sulfuric amino acid (methionine and cystine). Besides cottonseed kernels lack of sulfuric amino acid, they also lack of aromatic amino acid (phenylalanine and tyrosine).

Table 4. Amino acids content in protein of cotton seed, soybean and rubber seed

	Cottonseed[1])	Soybean[2])	Rubberseed[3])
Lysine	5.31	6.20	0.64
Histidine	3.55	2.42	0.35
Arginine	13.31	6.80	1.96
Aspartic acid	10.82	-	1.72
Threonine	3.89	3.95	0.58
Serine	5.34	-	0.82
Glutamic acid	24.15	-	2.82
Proline	3.74	-	0.82
Glysine	5.06	5.16	0.70
Alanine	5.06	-	0.80
Cystine	-	1.45	0.24
Valine	4.84	5.11	1.13
Methionine	1.08	1.45	0.43
Isoleunine	2.37	5.74	0.51
Leucine	4.37	7.86	1.06
Tyrosine	0.94	3.24	0.41
Phenylalanine	0.56	5.03	0.65
Thryptophan	-	2.42	-

1) Saroso and Damardjati (1988)
2) Stosic and Kaykay (1981)

Based on FAO pattern (1973), the protein of cottonseed flour lacks some essential amino acids i.e : sulfuric amino acid, aromatic acid, leucine and isoleucine (Saroso and Damardjati, 1988).

The comparison of essential amino acids in the protein of cottonseed flour with total protein (% e.a.a) at intervals 39.3- 41.7 % amino acid score (a.a.s) reach 96.5 and protein efficiency ratio (PER) at intervals 0.88-1.80. These values indicate that protein quality of cottonseed kernels are quite good for meals. FAO (1973) had stated a limit to compare essential amino acid with total of protein 36 %, amino acid score 58-74.

If it is compared with amino acid content in soybean can obviously complete to each other. So, the flour of cottonseed kernels are good for complement to compose together with soybean. Some lack of amino acid in soybean can be completed by amino acid of protein in cottonseed flour.

CONCLUSION

Protein content in cottonseed kernels is quite high and it can reach 36.6 % compared with soybean 34.1 %. Composition of protein fractions in the cottonseed kernels resemble soybean or peanut, therefore if it is used in composing mixed feed it will produce a prepared material which posses chemical and physical properties relatively similar. Solution and in vitro digestibility with pepsin are 92.9 % and 77.8-85.9 respectively.

Base on the FAO pattern (1973), the protein of cottonseed kernels lack some essential amino acids i.e. : methionine, cystine, phenylalanine, tyrosine, leucine and isoleucine.

The flour of cottonseed kernels is quite good for composing mixed feed together with soybean flour because its amino acids content can complement other.

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