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Submission date: 17-Jan-2023 11:51AM (UTC+0700)

Submission ID: 1993948563

File name: tamawati_2021_IOP_Conf._Ser._Earth_Environ._Sci._888_012069.pdf (708.99K)

Word count: 2571

Character count: 12587

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To cite this article: R T Hertamawati *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **888** 012069

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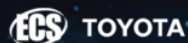
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Edamame soybean protein concentrate as a source of amino acid nutrition for poultry

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Abstract. This study aims to determine the opportunity and characteristics of edamame soybean protein concentrate (eSPC) as a source of amino acid. In this study, edamame soybean protein concentrate (eSPC) was manufactured using various methods of manufacturing solvent-based materials. This experiment consisted of two different methods, namely washing with acid and ethanol solvent. The results of manufacturing eSPC were analyzed for nutrients, especially the protein and amino acids contents. From the presentation and description of data, the best results of edamame soybean processing into protein concentrate (eSPC) was obtained in the acid method with a protein content of 48.83% and a total of 36.66% amino acids. The highest content of lysine was obtained at eSPC processing using 3.77% of acid, while methionine highest was with approximately 1.12%. These results showed that the eSPC is well used as a source of lysine and methionine in poultry feed.

1. Introduction

Unlike most plants, edamame soybeans are a whole protein source that provides all the essential amino acids the body needs, although not as high-quality as animal protein. Meanwhile, the existence of this soybean as one of the products of the Jember region makes it a regional superior product. In this region, edamame that meets export quality is shipped to Japan, while those with low quality of approximately 15% of the total production are sold at low prices.

The high price of protein-based feed ingredients has led to the search for alternative sources such as the use of edamame. This is because the protein content in edamame can be concentrated and used as an alternative source for animal feed.

Meanwhile, the edamame soybean protein concentrate is a product of soybean flour, which is made by removing half of its carbohydrates and a portion of its minerals to increase the protein fraction. This product is required to contain protein of at least 70% dry weight and the desired concentrate since it is the functional properties of the protein [1]. Moreover, there are several studies on the use of soybean protein concentrate as a substitute from animal sources, especially on broiler chicken feed [2] and pigs [3]. The soybean protein concentrate (SPC) is used as an alternative to animal protein to improve feed efficiency. The results of these studies showed that soybean protein concentrate is an ingredient that is used in poultry diets in replacement of the meal. This is because it contains certain benefits due to its processing, which includes lower levels of oligosaccharides such as raffinose, stachyose, and verbascose, higher crude protein, digestible, and metabolizable energy compared to soybean meal.

The soybean protein concentrate from rejected edamame is expected to be used as a protein substitute for fish meals or soybean meals. The use of rejected edamame as a source of nutrition and feed additives



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has been examined from the active ingredients of isoflavones in broiler chickens [4] and quail [5], however, study on the amino acid content has not been carried out.

Therefore, this study aims to produce edamame soybean protein concentrate as a poultry feed ingredient and determine whether the concentrate can replace fish meal in poultry, especially protein and amino acid content.

2. Material and methods

2.1. Sample preparation and processing of edamame soy protein concentrate

In this study, the ingredients tested were (1) edamame soybean (edamuki) and (2) soybean seeds and coats. These ingredients were washed, dried, and floured to obtain the full-fat flakes. Meanwhile, protein concentrate is made from non-fat soy flour that has eliminated half of its carbohydrates and minerals. The manufacturing of defatted soy flakes was carried out in line with the method of [6] by extraction with hexane. Furthermore, the edamame soy protein concentrate was made using two methods, namely washing with acid and ethanol. The procedure is shown in Figures 1 and 2.

2.2. Analysis of nutrient edamame soy protein concentrate

The protein concentrate obtained was proximately analyzed which included, moisture content (oven method), protein content (Kjeldahl method-semi-micro), fat content (Soxhlet method), ash content (dry ash method), and carbohydrate content (by difference) [7].

2.3. Amino acid analysis

The amino acid composition was determined using the HPLC device [8], which was rinsed with effluent and used for 2-3 hours, while the syringe was rinsed with distilled water. Meanwhile, the analysis of amino acids using HPLC consisted of 4 stages, namely: (1) the making of protein hydrolyzate, (2) the drying, (3) derivatization, (4) the injection and amino acid analysis stage.

2.4. Treatments and data analysis

This experiment consists of two treatments, which include washing with acid (HCl) and ethanol. The data observed were the nutrient contents as well as amino acids and were presented and discussed descriptively.

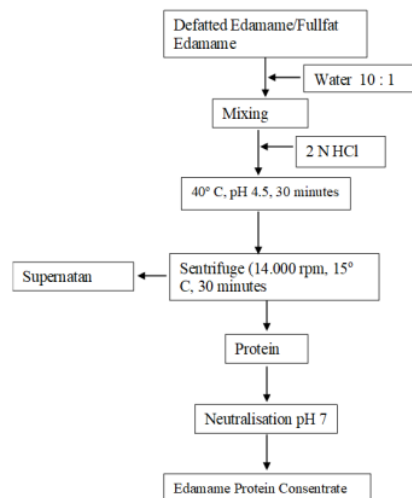


Figure 1. Acid washing method.

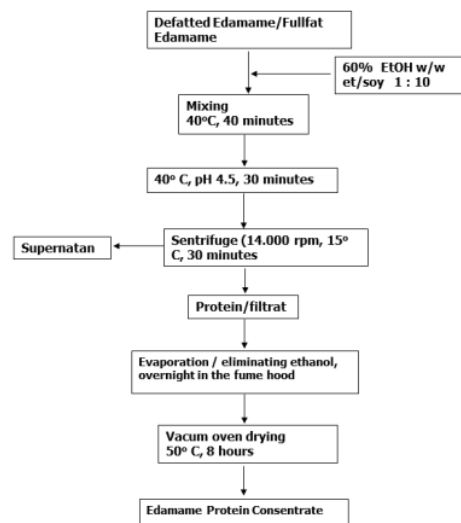


Figure 2. Ethanol washing method.

3. Result and discussion

3.1. Nutrients content of edamame protein concentrate

The nutrient content of eSPC is shown in Table 1.

Table 1. Nutrient content of edamame and eSPC.

Material	Nutrient Content			
	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Ash Contents (%)
Raw edamame	36.95±1.26	16.20±1.10	5.76±1.45	5.21±0.50
Boiled edamame	40.53±0.22	13.74±0.53	4.11±1.33	4.28±0.67
Full fat edamame powder	27.40±20.82	4.08±0.01	4.08±0.01	3.65±0.04
Defatted edamame powder	40.79±0.05	3.87±0.05	3.90±0.07	3.76±0.06
SPC Acid method	48.82±0.60	6.57±0.23	3.35±0.15	6.11±0.33
SPC Ethanol method	40.31±0.18	3.26±0.13	3.26±0.13	3.66±0.26

The eSPC protein content with the acid washing method (HCl) has a greater yield with an average of 48.83% than the ethanol which was only 40.31%. Compared to HCl, ethanol is a weak acid therefore, it is assumed to the causal role of the lower protein yield in the ethanol washing method. These results are consistent with the study by [9] where protein from herring (*Clupea harengus*) extracted with acidic solubilization yields materials with higher protein 92% than the extraction with alkaline of 89% (higher pH level solution).

In this study, the crude protein content produced was lower than the SPC production with a target of 70% [6]. This is in with a study by [10] which stated that the protein content increased from powder to concentrate with 56% and 72%, respectively, while the carbohydrate content decreased from 33.5% to 7.5%. Moreover, carbohydrate content analysis was not conducted in this study, while crude protein

analysis was carried out because the production of SPC is purposed for feed. Although the yields were below the target, eSPC with acidic solubilization HCl can be used as the substitution of the local quality fish meal since it contents >45% crude protein. Crude protein of eSPC with acidic solubilization is qualified to the minimum quality standards of fish meal, according to Indonesian National Standard (SNI), which required 45% of crude protein.

3.2 Amino acid content of edamame protein concentrate

Table 2 showed the amino acid content of edamame protein concentrate. Although the protein content of eSPC is lower than the good quality SPC protein standard, it is qualified as a few amino acid resources for poultry feed.

The total of amino acids in full-fat and defatted edamame, as well as eSPC, ranged between 27.04% and 36.83%. The highest yield produced with the acid method is on the average total content of amino acid with a value of 36.60%.

Table 2. Amino acid content produced from full-fat edamame, defatted edamame, and eSPC acid and ethanol method.

Amino Acid	Amino Acid Content (%)			
	Full fat edamame	Defatted edamame	eSPC Acid Method	eSPC Ethanol Method
Aspartate	1.455	1.495	0.98	0.88
Threonine*	0.45	0.44	1.39	0.29
Serine	0.365	0.365	1.49	0.12
Glutamate	2.495	2.41	2.585	1.42
Proline	0.825	0.815	2.09	0.49
Glycine	1.67	1.71	2.145	1.17
Alanine	1.53	1.555	2.1	1.27
Valin*	2.07	2.085	4.175	1.53
Methionine*	0.64	0.65	1.12	0.46
Isoleucine*	1.765	1.79	1.99	1.33
Leucine*	3.44	3.48	3.275	1.99
Tyrosine	1.855	1.9	1.47	1.09
Phenylalanine*	2.12	2.14	1.33	1.765
Histidine*	1.15	1.165	2.98	0.595
Lysin*	2.455	2.51	3.77	1.89
Arginine*	2.02	2	3.14	1.74
Tryptophan*	0.745	0.76	0.77	0.59
Total AA	27.05	27.27	36.80	35.45

The essential amino acid is needed for poultry, meanwhile, its value in eSPC with the acid method was higher than the ethanol method, soybean meal, and meat bone meal (MBM), while yields were at a lower level than the fish meal (Table 3). Lysine and methionine are the limiting essential amino acids commonly used in poultry feed mixtures. The required Lysine ranged from 0.45% to 0.85%, while methionine ranged from 0.10% to 0.32% [2][11]. The highest lysine content yield from eSPC processed with acidic solubilization of 3.77% which showed that the yields of eSPC with acidic solubilization are excellent for the lysine resource of poultry feed. In addition, the highest lysine content yields from the acidic solubilization to approximately 1.12%. These results showed that eSPC is excellent for methionine resources in poultry feed.

Table 3. The essential amino acid content comparison of eSPC with the acid method and ethanol method with protein resource feed.

Essential AA	eSPC (acid method)	eSPC (ethanol method)	Soybean Meal (CP 48%)**	Fish meal (CP 60%)**	MBM (CP 60%)**
Threonine	1.39	0.29	1.96	3.01	1.52
Valine	4.18	1.53	2.5	3.6	2.4
Methionine	1.12	0.46	0.72	1.82	0.71
Isoleucine	1.98	1.33	2.6	4.1	1.3
Leucine	3.27	1.99	3.7	5.0	3.3
Phenylalanine	1.33	1.76	2.5	2.7	1.6
Histidine	2.98	0.60	1.3	1.6	0.7
Lysine	3.76	1.88	3.22	5.28	2.68
Arginine	3.13	1.69	3.6	4.0	3.0
Tryptophan	0.77	0.59	0.71	0.58	0.36
Total AA essential	23.89	12.11	22.81	31.69	17.57

Annotation: ** [12]

4. Conclusion

Based on the results, the best processing of edamame protein concentrate (eSPC) is the acid method, with the protein content of 48.83%, a total amino acid of 36.6%, and essential amino acid of 23.89%. Furthermore, the highest lysine methionine yields from the acid method were 3.37% and 1.12%, respectively. These results showed that eSPC with the acid method can be used as the feed material for protein resources and essential amino acids (lysine and methionine source) in poultry feed.

References

- [1] Liener I E 1994 Implications of antinutritional components in soybean foods *Crit. Rev. Food Sci. Nutr.* **34** 31–67
- [2] Vasconcelos LG, Mello HHC, Stringhini JH, Andrade MA, Cysneiros CSS, Arnhold E, Mascarenhas AG, Resende MQ, and Xavier HPF 2017 Use of soy protein concentrate in pre-starter and starter diets for broilers *Brazilian J. Poult. Sci.* special edition nutrition/001-008
- [3] Sohn K S, Maxwell C V., Buchanan D S and Southern L L 1994 Improved soybean protein sources for early-weaned pigs: I. Effects on performance and total tract amino acid digestibility. *J. Anim. Sci.* **72** 622–30
- [4] Utami M M D and Hertamawati R T 2020 Dietary edamame soybean isoflavon concentrate on improving carcass quality of broilers *IOP Conf. Ser. Earth Environ. Sci.* **411**
- [5] Hertamawati R T, Nusantoro S and Rahma R 2021 Actions of edamame soybean isoflavones in an avian model: the Japanese quail (*Coturnix-coturnix japonica*) *IOP Conf. Ser. Earth Environ. Sci.* **672** 012043
- [6] Peisker, M 2001 Manufacturing of soy protein concentrate for animal nutrition *Brufau J. (ed.)*. Feed manufacturing in the Mediterranean region. Improving safety: From feed to food. Zaragoza : CIHEAM, p. 103-107
- [7] Μάρτινα 2019 No Title *ΕΛΕΝΗ Αγροτ* **8** 55
- [8] Wang H, Johnson L A and Wang T 2004 Preparation of soy protein concentrate and isolate from extruded-expelled soybean meals *JAOCs, J. Am. Oil Chem. Soc.* **81** 713–7
- [9] Undeland I, Kelleher S D and Hultin H O 2002 Recovery of functional proteins from herring (*Clupea harengus*) light muscle by an acid or alkaline solubilization process *J. Agric. Food Chem.* **50** 7371–9
- [10] Johnson L A 1999 Process for Producing Improved Soy Protein Concentrate From Genetically-

Modified Soybeans *US Pat. 5936069*

- [11] Aftab U 2019 Energy and amino acid requirements of broiler chickens: Keeping pace with the genetic progress *Worlds. Poult. Sci. J.* **75** 507–14
- [12] Leeson S and Summers J D 2009 *Commercial Poultry Nutrition* 3rd Ed. Nottingham University Press

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