Reduction Model of Cyanida and Protein Content on the Jackbeans Using CMS Method (Circulation Moxing System)

by Tantan Widiantara -

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PARALLEL SESSIONS

13.30-15.10	**Session 1a. New Challenges in Food Industry (Moderator: Abu Amar– Head of PATPI Jakarta)**		**Session 1b. New Challenges in Food Industry (Moderator: Anton Rahmadi –Head of PATPI East Kalimantan)**		**Session 2. Innovations in Managing Food Safety and Quality (Moderator: Meta Mahendradatta – Head of PATPI South Sulawesi)**		**Session 3a. Advances in Nutrition and Health (Moderator: Eni Harmayani – Head of PATPI Yogyakarta)**	
13.30-13.50	**Lead Speaker 2.1.1:** Wheat-Soy Tempe Flour: Effects on the Rheological and Fermentation Characteristics of Wheat Flour Treated with Transglutaminase ***Erni S. Murtini*** *(Brawijaya University, Indonesia)*	FP-LS2.1.1	**Lead speaker 2.1.3:** Physico-chemical of Purified Glucomannan Flour Extracted from Porang Flour (*Amorphophallus muelleri* Blume) by Modified Ball Mill Methods ***Simon Widjanarko*** *(Brawijaya University, Indonesia)*	FP-LS2.1.3	**Lead Speaker 2.2.1:** Survival of *Salmonella* Enteritidis During Tempe Fermentation ***Lilis Nuraida*** *(Bogor Agricultural University, Indonesia)*	FSQ-LS2.2.1	**Lead Speaker 2.3.1:** Bioavailability and Metabolism of Anthocyanins to Assess Their Antioxidant Role in Physiological Condition ***Yana Cahyana*** *(University of Padjadjaran, Indonesia)*	NH-LS2.3.1
13.50-14.10	**Lead Speaker 2.1.2:** Functional and Rheological Properties of Composite Flour from Sweet Potato, Maize, Soybean and Xanthan Gum ***Elisa Julianti*** *(University of Sumatera Utara, Indonesia)*	FP-LS2.1.2	**Lead speaker 2.1.4:** Optimum Combination of Blanching and Drying Temperature of Dried Bamboo Shoot (*Dendrocalamus membranaceus* Munro) ***Adil Basuki Ahza*** *(Bogor Agricultural University, Indonesia)*	FP-LS2.1.4	**Lead Speaker 2.2.2:** Antimicrobial Activity of Polyphenol - Rich Extract Against *Streptococcus mutans* and *Candida albicans* from Cocoa Beans (*Theobroma cacao* L.) Infested by *Phytophtora palmivora* ***Sony Suwasono*** *(University of Jember, Indonesia)*	FSQ-LS2.2.2	Lead Speaker 2.3.2: Dietary Fiber Intake Among Normal and Overweight Elementary School Children and Its Correlation with Defecation Pattern ***Siti Madanijah*** *(Bogor Agricultural University, Indonesia)*	NH-LS2.3.2
14.10-14.25	Effect of Pretreatments on the Properties of Potato Flour Produced from Variety Granola ***Condro Wibowo*** *(Jenderal Soedirman University, Indonesia)*	FP-O05	Reduction Model of Cyanide and Protein Content on the jackbeans Using SMS Method (Circulation Mixing System) ***Tantan Widiantara*** *(University of Pasundan, Indonesia)*	FP-O15	Application of a Bacteriophages Cocktail to Control *Salmonella typhimurium* in Chicken Meat ***Agustin K. Wardani*** *(Brawijaya University, Indonesia)*	FSQ-O05	Green Cincau (*Premna oblongifolia* Merr) and Colon Health ***Samsu Udayana Nurdin*** *(Lampung University, Indonesia)*	NH-O05

FP-015

Reduction Model of Cyanide and Protein Content on the Jackbeans Using SMS Method

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Abstract: Jack beans (Canavalia ensiformis,L) is high enough vegetables sources, average in the interval 20 % - 27% soy protein content approaching .Jack beans is a local commodity that has potential as an alternative food source, to be processed food products. However jack beans has a weakness, that it contains a hiht enough cynide inhibits the development and processing products of plant protein sources. The purpose of this research is to study the reduction model of cyanide and protein content on the jack bean (Canavalia ensifomis L) using SMS (Sirkulasi Mixing Sistem) with correlation of variation rotation impeller speed and processing time.The design of the experiments conducted is a linear equation between the variation of rotation impeller speed (60,120,180 rpm) and processing time (9 hours), where each interval of 1.5 hours the jack beans was analyzed for cyanide an protein content.The results of this study shown that cyanide content at the rotation impeller speed of 180 rpm, 120 rpm and 60 rpm with 4.5 hours of processing time was 10.75 mg / kg, 13.35% and 15, 99%. While the protein content at the rotation impeller speed of 180 rpm, 120 rpm and 60 rpm with a processing time of 4.5 hours was 18.25%, 17.47% and 16.67%.

Keywords: *Cyanide, Protein, Decrease,Jjack beans, SMS Method (Sirkulasi Mixing Sistem)*

FP-016

Optimization of Extraction and Production of Bay Leaves (*Syzygium polyanthum*) Extract Microcapsules

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Abstract: This research is aimed to determine the optimum condition of bay leaves on yield parameter and Total Soluble Solid (TSS) with combinations of extraction time (4, 6 and 8 minutes) and ratio between bay leaves and solvent (10:100, 15:100 and 20:100 (w/v)) and to know the effect of the best material which form bay leaves extract walls with combination of maltodextrin : Arabic gum : optimum condition bay leaves extract (100% : 50% : 50%) and combination of maltodextrin : natrium caseinate : optimum condition bay leaves extract (100% : 50% : 50%). In the data processing using Response Surface Methodology (RSM), it is known that the equation of yield optimization of bay leaves extract is $Y_1 = 17.13717 + 0.1706X_1 - 3.9606X_2 + 0.8161X_1^2 + 1.1594X_2^2 - 0.9550X_1X_2$. Optimum yield of bay leaves extract resulted is 19.87% which is obtained in 3.6508 minutes and ratio between solvent and extract is 4.041 : 100. The equation of Total Soluble Solid (TSS) optimization of bay leaves extract is $Y_2 = 22.2663 + 0.5167X_1 - 0.6611X_2 + 0.1389X_1^2 + 1.889X_2^2 - 0.2169X_1X_2$. The optimum TSS of bay leaves extract resulted is 22.789°Brix which is obtained in 8.1652 minutes and ratio between solvent and extract is 10.017 : 100. In microencapsulation step, it is used two variations of coating material namely maltodextrin : Arabic gum and maltodekstrin : Na-Caseinate. The yields resulted respectively are 19.8063% and 20.2751%, water level resulted are 4.6640% and 5.3925% respectively, solubility in water are 98.6294% and 98.6353%, microstructure forms resulted are spread-smooth-round and spread-smooth-round, the colors resulted are reddish yellowish white and reddish yellowish white, level of solvents residue resulted are 0.01% and 0.01% and content of the active compounds (% fenol) resulted are 15.32% and 29.29%.

Keywords: *extraction, bay leaves extract, extraction optimization, microcapsule*

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Abstract

Jackbeans (Canavalia ensiformis,L) is an high source of vegetable protein, in average, it almost approached the protein content on soy at the interval of 20 % - 27%.Jack beans is a local commodity that has potential as an alternative food source to be processed as a food products. However jackbeans has a weakness, it contains a high cyanide that can inhibits the development and process of this vegetable protein sources

The purpose of this research is to study the reduction model of cyanide and protein content on the jack bean (Canavalia ensifomis L) using CMS (Ciculation Mixing System) with the correlation of impeller speed variations and processing time. The design of the experiments conducted is a linear equation between the variation of rotation impeller speed (60,120,180 rpm) and processing time (9 hours), where each interval of 1.5 hours the jack beans was analyzed for cyanide and protein content.

The results of this study shown that cyanide content at the rotation impeller speed of 180 rpm, 120 rpm and 60 rpm with 4.5 hours of processing time was 10.75 mg / kg, 13.35% and 15, 99%. While the protein content at the rotation impeller speed of 180 rpm, 120 rpm and 60 rpm with a processing time of 4.5 hours was 18.25%, 17.47% and 16.67%

Keywords: Cyanide, Protein, Decrease, Jackbeans, CMS Method (Circulation mixing system)

INTRODUCTION

Jackbeans *(Canavalia ensiformis*), is widely grown in South and Southeast Asia, particularly in India , Sri Lanka , Myanmar and Indo-China. Jackbeans has now spread throughout the tropics and has become naturalized in some areas in Indonesia, including Central Java . In 2010-2011 was recorded from an area of 24 hectares in 12 districts in Central Java has produced 216 tons of jackbeans every harvest (Blora Regency , Banjarnegara, Temanggung , Pati , Kebumen, Purbalingga , Boyolali , Batang , Cilacap , Banyumas , Magelang , and Jepara (Sri Budi, 2013) .

Jackbeans (Canavalia ensiformis) is one of the legumes that have potential as a source of food. Protein content of jackbeans is nearly the content of protein in soybeans (30-40 %), whereas the protein content on the jackbeans ranges between 20-30 %.

It can be seen that jackbeans is local food that has a potential to be developed into vegetable protein sourced food product. Development of products made from jackbeans is expected to substitute, reduce or even later can replace soy protein, so that the need and dependence on soybeans can be controlled.

One of the things that become obstacles in the utilization and development jackbeans as a food source, is the content of gynogenic glycosides in jackbeans that can break down into cyanide which is poisonous (toxic). Cyanide is a toxic compound that can damage the health and reduce the absorption of nutrients in the body. Cyanide is a poison that reacts quickly, gaseous, odorless and colorless like hydrogen cyanide (HCN) or in the crystal form such as sodium cyanide (NaCN) or potassium cyanide (KCN). Cyanide is also often found in bay leaves, cherry, sweet potatoes, and other nuts family, such as almonds (Main, 2006, in Tintus, 2008) .

Jackbeans beans *(canavalia ensiformis)* contain HCN of 11.2 mg / 100 g dry weight (Akpapunam et al .1997). According Novianti (2012) in Suciati (2012) HCN has a normal limit of consumption of < 50 ppm or mg / kg .

Cyanide toxicity reduction methods in foodstuffs especially jackbeans has been done, which the most common is by boiling and soaking with the addition compound of sodium bicarbonate (NaHCO3). Another methods that usually do including: soaking with the addition of salt, sodium bicarbonate, sodium bisulfate, ash, drying, steaming, and fermentation.

According to Kam Nio (2008) in Sartika (2009), for removing hydrogen cyanide (HCN) from the food , is by boiling and discard the water, or peeled and washed with running water.

Sartika's research in 2009 about cyanide reduction methods by boiling. The results showed that the longer the boiling, the cyanide levels will decrease, it is caused by the nature of the cyanide that is volatile and soluble in boiling water . Research of Prastyo and Triaji (2011) to reduce cyanide on yam tuber that is by steaming , where the most optimum time to reduce the cyanide in yam tubers is 75 minutes .

Research of Surhaini, et al (2009) modification of size reduction process and increased salt concentration can accelerate the removal of toxins from the tubers of yam. The decrease of dioskorin toxic substances to the safe limit occurs at a salt concentration of 7.5 %

or more and soaking time 9 hours or more. The optimum treatment to eliminate the toxin in yam tuber is the use of salt at a concentration of 7.5 % and a 12 -hour soaking time.

Therefore, it is necessary to develop research that leads to a correct method, on reducing the cyanide content of the jackbeans optimally with minimal reduction to the protein content. From research and treatment or treatment to reduce the cyanide content on jackbeans that has been done, can be a basic research tool in designing CMS machine (mixing circulation system) . CMS Machine (circulation mixing systems), it is a tool that is designed to reduce the content of cyanide in jackbeans. The principle of this instrument is a system of agitation (mixing) given the jackbeans soaked with the soaking water and circulated continuously in a certain time.

Method of mixing circulation system is a combination of the method of immersion with agitation method assisted by the circulation of the solution soak. Stirring will help contact the object with a solution more evenly and simultaneously. Solution circulation flow continuously, that can reduce residual cyanide in solution event thus avoiding periodic replacement solution. In addition, with this method are expected to decrease processing time of cyanide in jackbeans to be more effective than treatments that have been carried out.

METHODOLOGY

The main materials for this research are jakbeans and CMS machine, the jackbeans are used for raw material and CMS machine is a tool for helping decreasing cyanide content on jackbeans using CMS method (Circulation Mixing System). First step for this research is analysis of the nutriens and anti nutrient content on the jackbeans (carbohydrate, protein, water, lipid and cyanide), and secondary step is doing experimental research to decrease cyanide and protein content on the jackbean using CMS method (circulation mixing system).

Figure 1. Jackbean (Canavalia ensiformis)

Figure 2. CMS Machine
(circulation mixing system)

The design of the experiments conducted is a linear equation between the variation of impeller speed rotations (60,120,180 rpm) and processing time (9 hours), where every 1.5 hours intervals the jack beans was analyzed for cyanide and protein content.

Model mathematic is :

$$y = a + bx$$

The purpose of this research is to study the reduction of cyanide and protein content on the jackbean (Canavalia ensifomis L) using CMS (Circulation Mixing System) with correlation of impeller rotation speed variations and processing time.

Table1. Reduction of cyanide content on the Jackbean With Variation Impeller Speed and Processing Time

Table 2. Reduction of Protein content on the Jackbean With Variation Impeller Speed and Processing Time

Figure 3. Flow sheet Reduction Of Cyanide and Protein Process Using CMS Method

RESULT AND DISCUSSION

The Jackbeans contains nutrients and anti-nutrients, the chemical analysis carried out on raw materials such analysis to determine water, ash, protein, fat and carbohydrates contents (starch) as well as cyanide leves (HCN) as anti- nutrients of jackbeans. The results of the analysis can be seen in Table 3.

Tabel 3. Analysis Result of Nutrient and Anti Nutrient on Jackbeans as Raw Material

Based on table 3, initial cyanide content in jackbeans was 67.05 mg / kg, this value is not a safe levels for consumption, because the minimum level cyanide for consumption is below 50 ppm (≤ 50 mg / kg) or 0.5 to 3.5 kg/mg per body weight (Dreisbach, 1980: in Donatus et al., 1992). For the initial protein content is 21.90 % , this number is quite high for this type of nuts, the average protein content on jackbeans range from 20 to 30 %. It is almost as high as protein content on soybeans. Thus CMS method is expected to reduce the content of cyanide to the maximum and with minimum decline on protein content .

1. Cyanide Decreasement

This experiment aims to determine and study the correlations decrease in cyanide content based on mixer rotation speed and processing time using CMS tool (machine). Stirrer rotation speed to be used consists of 60, 120 and 180 rpm and 9 hours of processing time with 1.5 hours interval.

Table 4. Cyanide content decrease using CMS Method

As shown on Table 4 the results of diminshing cyanide content every 1.5 hour for 9 hours processing time for each variation of stirrer rotation speed. Rotation speed at 180 rpm reduces cyanide content to 10,75 mg / kg , this situation can be summed up as optimal results due to the time produced is 4.5 hours. This condition can be caused by the rotation of the stirrer provide friction that can increase the surface so that the jackbeans cyanide content can be more quickly soluble by water, in addition the stirrer rotation also generates heat and hot water is delivered through the medium of immersion so can accelerate the reducing of cyanide content. The faster the rotation, the more heats were produces to the water. Water has a thermal conductivity which is good so it will be delivered by the water evenly in the food.

According to Amalia (2011) stated that HCN compounds easily evaporate in the process of boiling , steaming , and other heating processes, due to the volatile nature of HCN at room temperature , HCN has a distinctive odor and easy to diffuse .

In general, toxic compounds are in a space that is inside the cell (vacuoles) and the enzyme is in the cytoplasm. Tissue damage to both compounds causing collage and reaction. But by immersion in water, the formed compound by the reaction will be dissolved, whereas compounds in the cell will diffuse out. With the softening of tuber tissue, toxic compounds and other compounds contained in the cell will exit (Djafaar et al, 2009).

From table 4 can be described the relationship between the rotational speed of the stirrer with a decrease in the content of cyanide process with linear regression chart below

Figure 4. Linear regression of Cyanide content reduction at 60 rpm rotation Impeller speed

Figure 5. Linear regression of Cyanide content reduction at 120 rpm rotation Impeller speed

Figure 6. Linear regression of Cyanide content reduction at 180 rpm rotation Impeller speed

Figure 4,5 and 6 above shows the circulation of water treatment and stirring for 1.5 hours , 3 hours , 4.5 hours , 6 hours , 7.5 hours and 9 hours with a rotation speed of 60 rpm showed a correlation coefficient of linear regression is r = 0.48 . For the same processing period but with rotation speed of 120 rpm and 180 rpm, showed a correlation coefficient of linear regression for each processing are r = 0.48 and r = 0.46. The coefficient values show an association of rotation speed and processing time to the decreased levels of cyanide in jackbeans that indicated by positive value of coefficient (r). This positive correlation indicates a direct linear relationship between the rotational speed and processing time at decreased levels of cyanide. The period time treatment and rotation speed is a direct influence on the decreased levels of cyanide, because with the rotation of the stirrer mass of water molecules being transferred into food with due to collisions between foodstuffs and the agitator stirrer so cyanide is diffuse into water.

The rotational speed of the stirrer is done with processing time from 1.5 hours to 9 hours can lead to skin peeling of the jackbean, the faster the rotation caused faster turnaround the stirrer to open jackbean skin. This causes the cyanide contained in jackbeans decreased due skin opening and carried away by the circulation water into the filter. Softening occurs while soaking the pore network and so transferred material capable of passing membrane permeable (Djafaar et al , 2009) as well as circulation and agitation can help open the skin surface of jackbeans so that the tissue being softening . Suhaidi (2003) stated that the longer the immersion which also resulted in the structure of its soy beans so that the water is more easily enter the cell structure so that cyanide is present in the cell will come out and dissolve in water .

As one of the factors that can influence the levels of cyanide in the lentils sword other than temperature is the quality of the water used in soaking method. The water quality must comply with the requirements of standards water quality both physical and chemical . Physical water quality requirements such as : colorless , odorless , normal temperature , and does not contain solids . While the chemical requirements are: pH neutral (6.5 to 8.5) , the normal

hardness where hardness for drinking water standard class is a maximum of 500 mg / L , ferrous metals contained in a maximum water 0.3 mg / L .

2. Protein Decreasement

This experiment aims to determine and study the correlations in Protein content decreasement based mixer rotation speed and processing time using CMS tool (machine). Stirrer rotation speed to be used consists of 60, 120 and 180 rpm and 9 hours of processing time with interval of 1.5 hours

Table 5. Protein content decrease using CMS Method

Based on Table 5 above shows that the protein content decreases each interval time of 1.5 hours process for 9 hours , but the amount of decrease in protein content was not as high as the decrease of cyanide content. The percentage decrease of protein for 9 hours was 20.15 % for the rotation speed of 60 rpm stirrer, 21.17 for the stirrer rotation speed 120 rpm and 21.20 % for the stirrer rotation speed of 180 rpm.

The factors that affect the solubility properties of protein are ionic strength, pH, temperature, particle size, and production processes. Effect of pH based on the difference in charge between the amino acids that make up proteins. At a certain pH the charge difference may reach zero or equilibrium. This is known as the isoelectric point. At the pH of the protein has an interesting attraction is the most powerful among themselves (Lehninger ,1997).

Proteins affected by the hot conditions and the solubility, dissolution rate of various proteins and protein affect the type of solvent, there are soluble by water or solvent.

According Triyono (2010), the heat treatment can provide beneficial and detrimental effects on proteins. Beneficial effect is the increased efficiency of protein, because of the heating process or decrease the processing can inactivate anti- nutritional substances that inhibit protein especially. But warming will make denatured protein material decreases its water binding capabilities. Immersion, water immersion and circulation agitator rotation on the method of circulation system does not really give the impact to the decline of protein, this can be due to the heat caused by the stirrer rotation is not high enough to denaturized protein on the jackbeans. The factors of circulated water immersion possible influence the protein decrease on jackbeans, albumin proteins that exist in jackbeans will dissolve due to the soaking water is circulated during the time of the process because the protein albumin has a water-soluble properties . From table 5 can be described the relationship between the

rotational speed of the rotation with a decrease in protein content processes with linear regression chart below

Figure 7. Linear regression of Protein content reduction at 60 rpm rotation Impeller speed

Figure 8. Linear regression of Protein content reduction at 60 rpm rotation Impeller speed

Figure 9. Linear regression of Protein content reduction at 180 rpm rotation Impeller speed

Figure 7,8 and 9 showed the rotational speed of the impeller that varies 60 rpm , 120 rpm , and 180 rpm with range of 1.5 hours to 9 hours showed levels of protein on the jackbeans are decreased .

Circulation stirrer system processing time of 1.5 hours , 3 hours , 4.5 hours , 6 hours , 7.5 hours , and 9 hours with a rotation speed of 60 rpm shows the linear regression coefficient was r = 0.91 . For treatment of process with the same time as above with the rotational speed of the stirrer used 120 and 180 rpm , showing the linear regression coefficient values for each treatment are r = 0.82 and r = 0.80 . In the figure 7 Shows the correlation of time and speed the process of rotation of the decreased levels of the protein on jackbeans indicated by the value of coefficient (r) is positive . This positive correlation indicates a direct linear relationship between the rotational speed and processing time in decreased levels of the protein. The time and speed of stirrer circulation is a direct influence on the decreased levels of cyanide, because with the rotation of the stirrer can generate heat delivered to the water, but the heat generated by the stirrer rotation does not cause a high decrease on protein content.

CONCLUSION

This research has a conclusion that variation of impeller rotation speed and processing time has correlation to reduce cyanide and protein content on the jackbeans according linier regression which is using CMS method (Circulation Mixing System). The results of this study shown that cyanide content at the rotation speed of 180 rpm, 120 rpm and 60 rpm with 4.5 hours of processing time was 10.75 mg / kg, 13.35% and 15, 99%. While the protein content at the rotation speed of 180 rpm, 120 rpm and 60 rpm with a processing time of 4.5 hours was 18.25%, 17.47% and 16.67% The CMS method showed that 180 rpm rotation speed with processing time 4,5 hour is the optimize result in this research to reduce the cyanide content on the jackbean.

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Figure 1. Jackbean (Canavalia ensiformis)

Figure 2. CMS Machine (circulation mixing system)

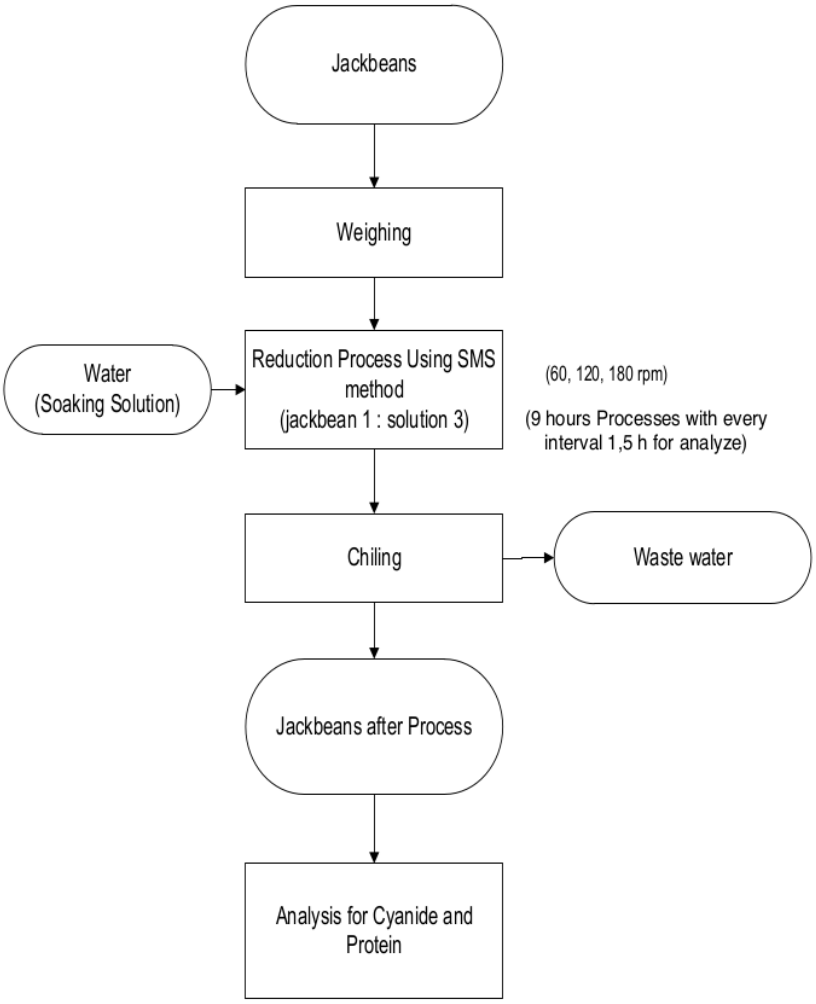

Figure 3. Flow sheet Reduction Of Cyanide and Protein Process Using CMS Method

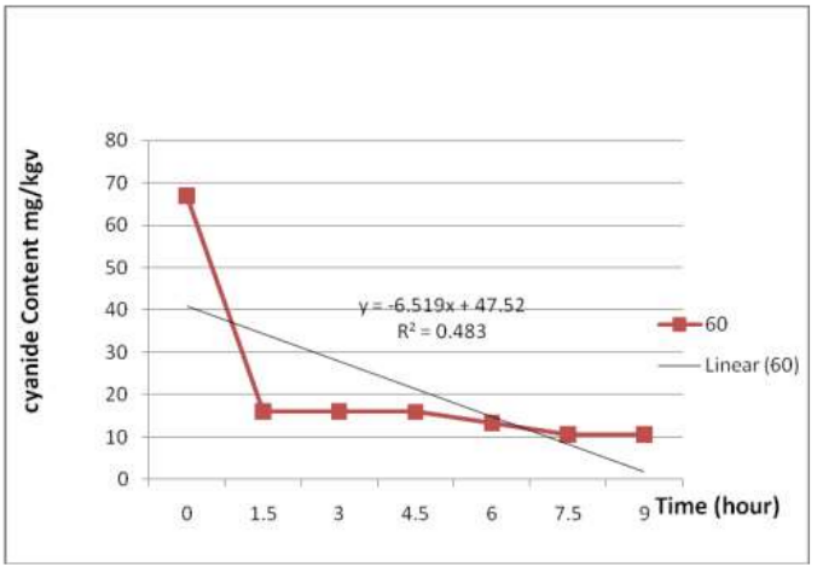

Figure 4. Linear regression of Cyanide content reduction at 60 rpm rotation Impeller speed

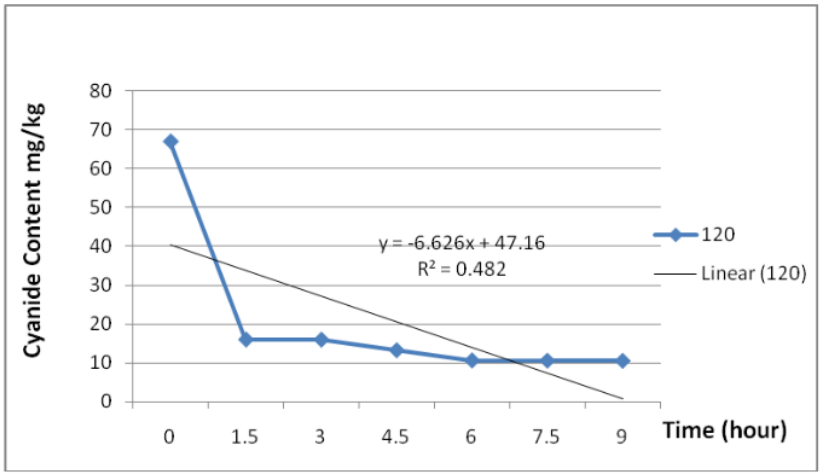

Figure 5. Linear regression of Cyanide content reduction at 120 rpm rotation Impeller speed

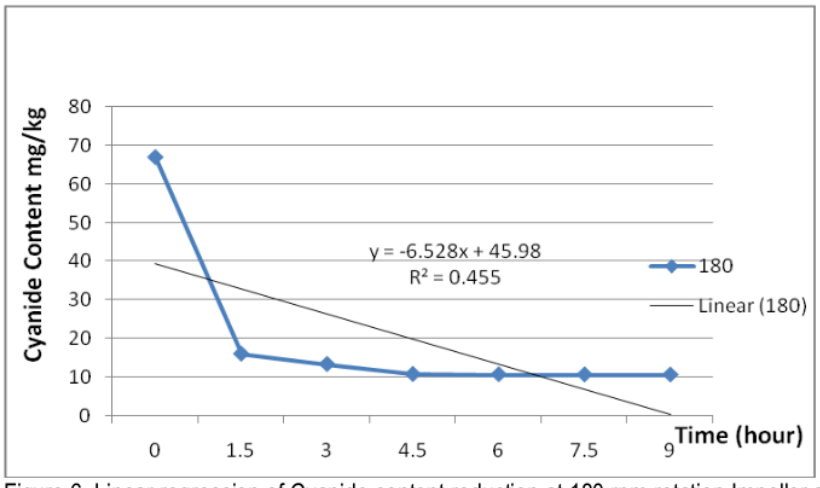

Figure 6. Linear regression of Cyanide content reduction at 180 rpm rotation Impeller speed

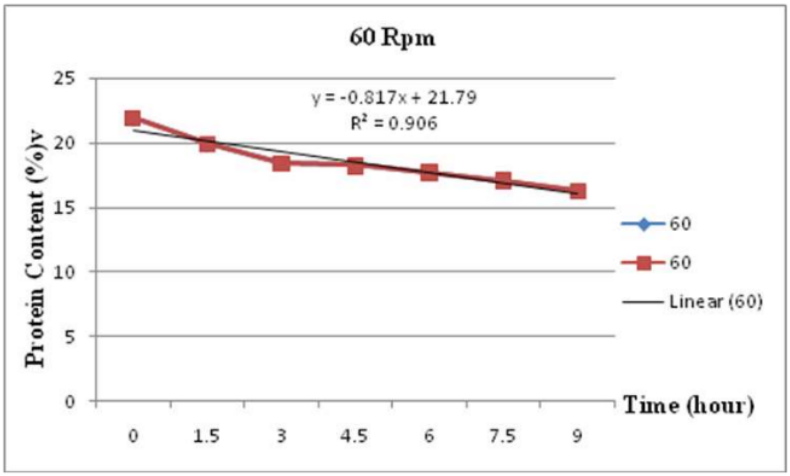

Figure 7. Linear regression of Protein content reduction at 60 rpm rotation Impeller speed

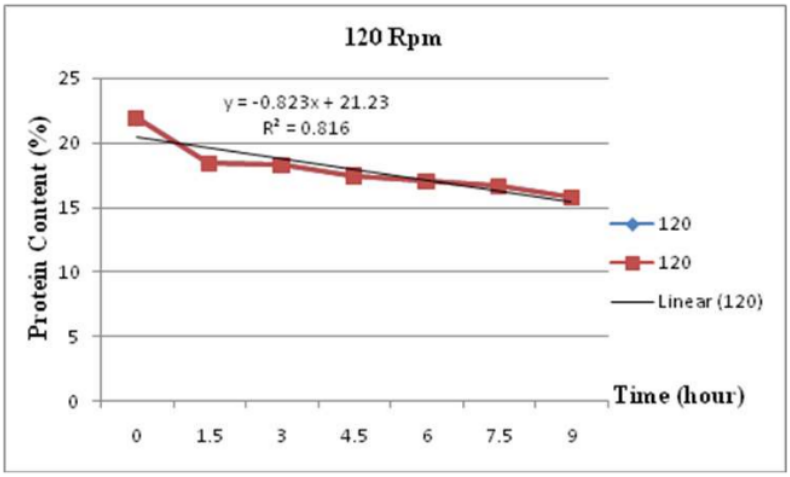

Figure 8. Linear regression of Protein content reduction at 60 rpm rotation Impeller speed

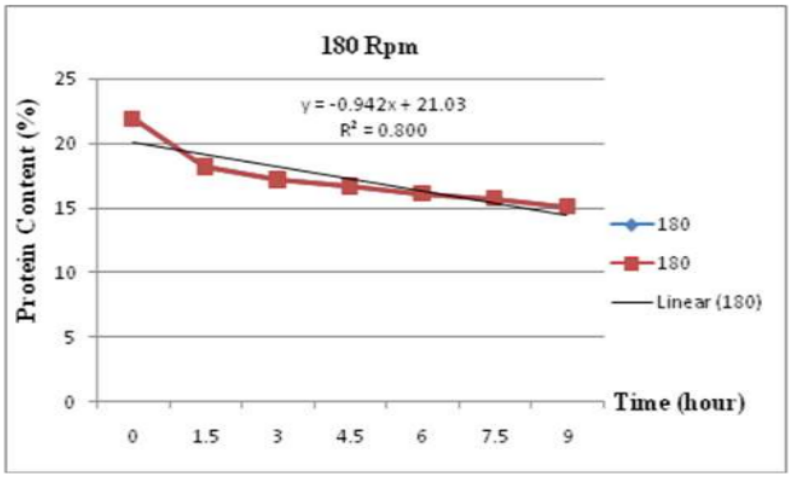

Figure 9. Linear regression of Protein content reduction at 180 rpm rotation Impeller speed

Table 1. Reduction of cyanide content on the Jackbean With Variation Impeller Speed and Processing Time

RPM	Cyanide Content (mg/kg)						
	0 (h)	1.5 (h)	3 (h)	4.5 (h)	6 (h)	7.5 (h)	9 (h)
60							
120							
180							

Table 2. Reduction of Protein content on the Jackbean With Variation Impeller Speed and Processing Time

RPM	Potein Content (%)						
	0 (h)	1.5 (h)	3 (h)	4.5 (h)	6 (h)	7.5 (h)	9 (h)
60							
120							
180							

Tabel 3. Analysis Result of Nutrient and Anti Nutrient on Jackbeans as Raw Material

No.	Component	Content (%)
1.	Water	15,469
2.	Ash	0,97
3.	Protein	21,89
4.	Lipid	2,17
5.	Carbohydrate (Starch)	47,95
6.	HCN	67,05 mg/kg

Table 4. Cyanide content decrease using CMS Method

RPM	Cyanide Content (mg/kg)						
	0 (h)	1.5 (h)	3 (h)	4.5 (h)	6 (h)	7.5 (h)	9 (h)
60	**67.05**	**16.12**	**16.12**	**15.99**	**13.40**	**10.78**	**10.67**
120	**67.05**	**16.11**	**16.07**	**13.35**	**10.73**	**10.66**	**10.62**
180	**67.05**	**16.02**	**13.35**	**10.75**	**10.68**	**10.63**	**10.60**

Table 5. Protein content decrease using CMS Method

RPM	Protein (%)						
	0 (h)	1.5 (h)	3 (h)	4.5 (h)	6 (h)	7.5 (h)	9 (h)
60	**21.89**	**19.89**	**18.43**	**18.25**	**17.75**	**17.12**	**16.33**
120	**21.89**	**18.41**	**18.29**	**17.47**	**17.05**	**16.64**	**15.80**
180	**21.89**	**18.2**	**17.18**	**16.67**	**16.10**	**15.72**	**15.12**

Reduction Model of Cyanida and Protein Content on the Jackbeans Using CMS Method (Circulation Moxing System)

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