International Journal of Food Science and Nutrition
ISSN: 2455-4898; Impact Factor: RJIF 5.14
Received: 01-11-2019; Accepted: 03-12-2019
www.foodsciencejournal.com
Volume 5; Issue 1; January 2020; Page No. 01-03

A Study of the effect of glucono delta lactone concentration (GDL) on the koro curd productionfrom koro bean: *Canavalia Ensiformis*

Syarif Assalam[1], Imas Siti Setiasih[2], Mohammad Djali[3], Sarifah Nurjanah[4]
[1] Agriculture Faculty, Padjadjaran University, Indonesia Jalan Raya Jatinangor KM 21 Jatinangor, Sumedang, Indonesia
[2-4]Agricultural Industrial Technology Faculty, Padjadjaran University, Indonesia

Abstract
White sword jack bean (koro bean) contains higher protein than the protein contained in tubers. The protein content of koro beanis 27.4%. With a fairly high protein content in koro beanit is possible to be able to process the coagulation of its protein content into a product of korocurd. The coagulation process is the most important step in making curd. Lactone coagulants, such as Glukono Delta Lactone, are widely used in the process of making silken curd with a soft texture. The method used in this research is the Randomized Block Design method. The variables examined in this study were the concentration of GDL 1.0% (w/v), 1.2% (w/v), 1.4% (w/v), 1.6% (w/v), 1 8% (w/v). The results of this study indicate that the GDL concentration of 1.8% (w/v) has a significant influence on the protein level of koro curd.

Keywords: koro bean, koro curd, glucono delta lactone, protein

1. Introduction

Beans are one of the potential natural resources of Indonesia that can be used as vegetable food. One type of bean that can be utilized is white sword jack bean (koro bean), where koro bean is also a type of bean as a source of protein that grows well in Indonesia, but its utilization by the community is not optimal [18]. Sword koro plants (*Canavalia ensiformis*) have long been known in Indonesia, but competition between plant species causes these plants to be excluded and rarely planted on a large scale. From the nutritional content, korobean has all the nutritional elements with a high nutritional value, such as carbohydrate 60.1%, protein 30.36%, and 8.3% fiber [15]. However, korobean has not been widely used by the public. Although the protein content of koro bean is lower compared to soybeans, the carbohydrate and fiber content is higher. In addition, koro has a lower fat content compared to soybeans, so korobean can be used as a safe food ingredient[3].With a high protein content, koro bean has the potential as a raw material for curd product making. Traditionally in making curds, coagulants are added to the bean extract while stirring vigorously using a paddle-shaped stirrer that lasts for some time[16]. The gel formation on the curd is formed through two stages such as protein denaturation and continued with the hydrophobic coagulation stage. The coagulation process occurs due to random interactions in protein molecules to form protein aggregates that are both soluble and insoluble [12].Curd formation involves a complex interaction of the coagulation process of salt or acid to form a water-based gel in which fat molecules and proteins are trapped in the gel [1].

Table 1: Nutrient Content of Koro Sword

No	Components	Percentage (%)
1	Water	3,80-13,5 %
2	Crude Protein	22,8-35,3 %
3	Albumins	7,80-8,60 %
4	Globulin	13,9-14,6 %
5	Prolamin	0,63-0,91 %
6	Glutelin	1,84-1,96 %
7	Crude Fat	1,60-12,1 %
8	Fibre	4,70-11,4 %
9	Ash	2,30-5,80 %
10	Total Carbohydrate	24,7-36,9 %
11	Digestible starch	26,1 %
12	Resistant starch	10,8 %
13	Crude carbohydrate	45,8-65,4 %
14	Energy	352,8-458,4 kkal

Source: Sridhar and Seena (2006)

The content of solids in soy milk, the concentration of coagulants and the temperature of soy milkare important in producing curd quality [9].The use of GDL can produce soft and compact curd [7]. Lactone coagulant types, such as Glukono Delta Lactone, are widely used in the process of making silken tofu with a soft texture [21].The use of GDL coagulants will reduce the pH of milk bean, causing aggregation of denatured proteins by increasing the hydrophobic nature and irregularity[13].GDL hydrolysis is slow and increases with increasing incubation

temperatures. The slow process of coagulation causes the curd produced to have a finer texture than the curd produced using acid type coagulants[19].The coagulation process in making silken tofu using GDL coagulant takes place in two stages; the first stage is protein denaturation by heat by rearranging the structure of the protein into a soluble complex. The second stage is the neutralization of the negative charge of denatured proteins which causes a decrease in electrostatic repulsion between complex proteins and subsequent clumping through hydrophobic interactions [8].

2. Materials and Methods

2.1 Materials

The material used in this research was koro bean which were obtained from farmers in Temanggung Central Java, water, and coagulant Glucono Delta Lactone (GDL) brand parchem obtained from local suppliers. Other supporting materials are Kjeldahl salt, concentrated H_2SO_4, 0.01N HCl, NaOH30%, boric acid2%, boiling stones and aquadest.

2.2 Tools

The tools used in this research are blender, pan, thermometer, stop watch, analytical balance, stirrer, filter cloth, pressing device, a set of distillation apparatus, measuring flask, erlen-meyer flask, burette, condenser, measuring pipette, drip pipette, boiling flask, Kjeldahlflask.

2.3 Methods

The research method used was an experimental method with a Randomized Block Design (RBD) approach consisting of five treatment conditions with five replications. If there are significant differences between treatments, the analysis is continued with Duncan's test.

The treatment design in this study consisted of one factor, the factor is the concentration of glucono delta lactone as follows:

C1 = 1% (b/v)
C2 = 1,2% (b/v)
C3 = 1,4% (b/v)
C4 = 1,6% (b/v)
C5 = 1,8% (b/v)

The response analysed in this study was protein content

The experimental model for this research is as follows:

1. $Y_{ij} = \mu + \tau_i + \beta_j + \varepsilon_{ij}$
2. i = 1, 2,…, t = number of treatments
3. j = 1, 2,…., n = number of repetition
4. Y_{ij}= the random variable representingthe response for treatment i observed in block j
5. μ = a constant (which may be thought of as the overall mean)
6. τ_i= the effect of the i^{th} treatment
7. β_j =block treatment the j^{th}
8. ε_{ij}= the random error for the i^{th} treatment in the j^{th} block

2.4 Development of Product

2.4.1 Flow chart for manufacturing of experimental koro curdas follows as fig.1

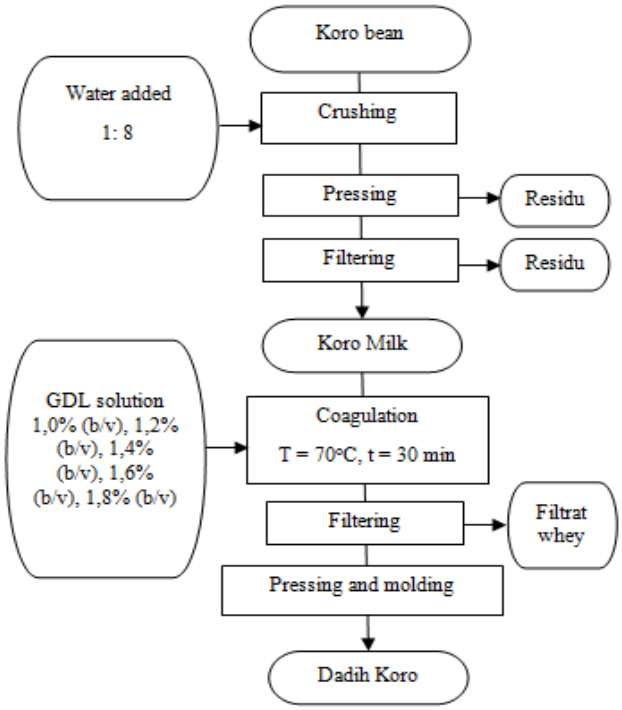

Fig 1

3. Result and Methods

Based on the analysis of Variance (ANOVA) on protein contentpresented in Table 2, it showed that the concentration of GDL affected to protein levels of koro curd. Based on the results of Duncan's tests showed that the coagulation process with a GDL concentration of 1.8% (w/v) showed a significant influence on the level of proteinkoro curd. Duncan's test results are presented in Table 3.

Table 1: ANOVA Data Results of Protein Level Analysis

Source of diversity	Free of degree	Sum of square	Mean of square	F Count	F Table 5%	F Table 1%
Block	4	0,09	0,02	0,30tn	5,84	14,15
Treatment	4	8,09	2,02	26,76**		
Error	16	1,21	0,08			
Total	24	9,39				

Note: tn = not significant, ** = significant

Based on the ANOVA table, it is known that F Calculate for the concentration of GDL ≥ F Table, which means that it is significantly different from protein levels, so Duncan's test needs to be done

Table 2: Influenceof Glucono Delta Lactone (GDL) Concentration on the Protein Levels of Koro Curd

GDL concentration	Mean Value	Level of significant 5%
1,6% (b/v)	19,77	A
1,4% (b/v)	20,00	A
1,0% (b/v)	20,12	A
1,2% (b/v)	20,21	A
1,8% (b/v)	21,40	B

Note: The same letter shows no significant difference at the 5% level according to the Duncan test

From the table above, it shows that the concentration of GDL coagulant compounds affects the protein content of koro curds. The coagulant will form a protein gel in which the gel traps water, fat and other constituents in the curd matrix [14].The amount of coagulant needed depends on the protein content of koro bean. The lack of the amount of coagulant used for coagulation will cause protein deposition to be imperfect and complicate the process of separating whey and curd.The amount of coagulant that is lacking will result in the formation of a curd matrix structure that is tenuous due to imperfections of deposition, consequently the curd formed is too soft. Conversely, excess coagulant will make the curd texture hard[2].Temperature and coagulant concentration added affect to the coagulation process and protein aggregation to become curd [6]. High coagulation temperatures cause the coagulation process to take place quickly and the bonds between proteins are getting tighter [22]. The type and amount of coagulant influences to the complex of interrelation process at the time of soymilk coagulation [4]. Curd solids are obtained through the process of protein denaturation, especially those caused by heat and coagulation which are influenced by cations of coagulant compounds[10].The formation of protein gel formation occurs through electrostatic repulsion associated with the process of gathering of proteins influenced by changes in the pH value in the protein solution to reach itsisoelectric point [5]. Coagulant GDL is hydrolysed gradually in water to form gluconic acid which can cause a decrease in pH value [11]. This is supported by the opinion, if a protein solution approaches the isoelectric point, the protein will be denatured and decrease in solubility and eventually the protein will clot and settle [20]

4. Conclusion

Based on the research, GDL solution with a concentration of 1.8% (w/v), has a significant influence on the protein content of koro curd. The percentage level of protein in koro curd produced from the coagulation process with a GDL coagulant solution of 1.8% (w/v) is 21.40%.

5. References

1. Benassi V, *et al*. A Statistical Approach to Define Some Tofu Processing Condition", Food Science and Technology (Campinas). 2011; 31(4):897-904
2. Blazek V. Chemical and Biochemical Factors that Influence the Gelation of Soybean Protein and the Yield of Tofu" (Thesis). Faculty of Agriculture, Food and Naural Resources. Univ of Sidney, Sidney, 2008.
3. Budi Widianarko, *et al*. "Tempe, MakananPopuler dan Bergizi Tinggi", Seri IptekPangan Volume 1, Teknologi Produk, Nutrisi dan KeamananPAngan. Jurusan Teknologi Pangan. UnikaSoegijapranata, Semarang, 2003.
4. Cai TD, Chang KC. Characteristic of Production Scale Tofu as Affected by Soymilk Cagulation Method: Propeller Blade Size, Mixing Time and Coagulation Concentrations", Food Res Int. 1988; 31:289-295
5. Cavallieri ALF *et al*. The Effect of Acidication Rate, pH and Ageing Time on the Acidic Cold Set Gelation of Whey Proteins", Food Hydrocolloid. 2008; 22:439-448.
6. Dahrul Syah, *et al*. The Influences of Coagulation Conditions and Storage Proteins on the Textural Properties of Soy-curd (tofu)", CyTA – Journal of Food. 2015; 13(2):259–263
7. De Man JM, *et al*. Texture and microstructure of soybean curd (tofu) as affected by different coagulants Food". Microstructure Food Techno journal. 1986; 5:83.
8. Guo ST, Ono T. "The Rule of Composition and Content of Protein Particles in Soymilk on Tofu Curdling by Glucono Delta Lactone or Calcium Sulfate", Journal of Food Science. 2005; 70:258–262
9. HJ HOU, *et al*. Yield and Textural Properties of Soft Tofu as Affected by Coagulation Method" 824-Journal of Food Science, 1987, 62(4).
10. Kaoru Kohyama, *et al*. "Rheological Characteristics and Gelation Mechanism of Tofu (Soybean Curd)", J. Agric. FoodChem. 1995; 43(7):1808-1812
11. Lucey JA, *et al*. A Comparison of the Formation, Rheological Properties and Microstructure of Acid Skimmilk Gels Made with a Bacterial Culture or Glucono-d-Lactone", Food Research International. 1989; 31:147 -155
12. Meng GT, *et al*. Thermal Aggregation of Globulin from an Ingredient Chinese Legume, Phaseolus Angularis (Red Bean)", J Food Chem. 2002; 79:93-103
13. Nishinari K, *et al*. Soy Proteins: A Review on Composition, Aggregation and Emulsification". Food Hydrocolloid. 2014; 39:301-318.
14. Obatolu VA., (2008), "Effect of Different Coagulants on Yield and Quality of Tofu from Soymilk". J Eur Food Res and Tech 226: 467 – 427
15. Riyanti Ekafitria dan Rhestu Isworo. "PemanfaatanKacang-KacanganSebagaiBahan Baku Sumber Protein UntukPanganDarurat", Lembaga IlmuPengetahuan Indonesia, Subang, Jawa Barat, 2013.
16. Shurtleff W, Aoyagi. ofu and Soymilk Production, the Book of Tofu", New Age Food Study Center, La Vayette, 1984, 2(5).
17. Sridhar KR, Seena S. Nutritional and antinutritional significance of four unconventional legumes of the genus Canavalia – A comparative study". Food Chemistry. 2006; 99:267–288
18. Tamaroh Siti. "Pengaruh Penambahan Kacang Tunggak (Vigna unguiculata) dan KonsentrasiBahanPenggumpal (CaSO4) Pada Sifat-SifatTahuSutera yang Dihasilkan". Jurnal. Yogyakarta: FakultasTeknologi Hasil Pertanian, Universitas Wangsa Manggala, 2005.
19. Trisna, Victor. PengaruhKonsentrasiKoagulan GDL (Glucono δ Lactone) dan SuhuAwalKoagulasiTerhadap Pola Elektroforesis Protein Terkoagulasi TerhadapMutuTektur Curd Kedelai (Glycine max)" Skripsi Teknologi Pertanian IPB, 2011.
20. Winarno FG. Kimia Pangan dan Gizi": PT Gramedia, Jakarta, 2002.
21. Yen Chang Tseng, Youling L Xiong. Effect of Innulin on the Rheological Properties of Silken Tofu Coagulated WuthGluocono Delta Lactone", Journal of Food Engineering. 2008; 90:511–516.
22. ZHI-SHENG LIU, *et al*. Optimal Coagulant Concentration, Soymilk and Tofu Quality as Affected by a Short-Term Model Storage of Proto Soybeans Journal of Food Processing and Preservation. 2007; 32:39-59.