

Indonesia Local Beans and Its Benefit as Functional Food

Djaafar TF*, Marwati T* and Purwaningsih

Postharvest Department, Assessment Institute for Agricultural Technology Yogyakarta, Indonesia

Corresponding author: Djaafar TF, Postharvest Department, Assessment Institute for Agricultural Technology Yogyakarta, Indonesia, Tel: +6281227925997, E-mail: titiekfd1212@gmail.com

Citation: Djaafar TF, Marwati T, Purwaningsih (2019) Indonesia Local Beans and Its Benefit as Functional Food. J Food Tech Food Chem 2: 105

Abstract

Indonesia has a diversity of local bean resources that are spread throughout the region. Local beans were found in Indonesia include cowpea (*Vigna unguiculata*), kerandang (*Canavalia virosa*), sword beans (*Canavalia ensiformis*), koro (*Canavalia gladiata*), gude (*Cajanus cajan*), faba (*Vabia faba*), komak (*Dolichos lablab*), etc. Some research results have revealed the potential of local beans as a source of good nutrition for the body healthy. This local bean has a high protein content about 22.9% to 37.4% so that it functions as a source of protein. In Indonesia, local beans are used as raw material for the processing of tempeh, tofu, and non-dairy milk. Local beans and its products contain good nutritional value and contain isoflavones which have functional benefit as antioxidants.

Keywords: Local Beans; Resources Diversity; Functional Benefit; Protein Source; Isoflavones

Introduction

Indonesia has the potential of local bean resources that are spread throughout the region. Local beans have the potential as a source of nutrition, especially protein. Some research results have revealed the potential of local beans as a source of good nutrition for the body healthy. Local beans contain protein, fat, dietary fiber, minerals and phenolic compounds that have health benefits [1-3].

Local bean plants have advantages, can grow on sandy land and nutrient-poor fields with high productivity (0.7 to 5.0 tons/ha) [4]. The exploration of the potential and utilization of local beans in Indonesia has been supported by various studies on processing technologies. The development of local bean processing technology is intended as a substitute for even soybean substitutes to produce soybean-equivalent products, improving product quality both physical and nutritional quality, improving the image and taste of the product. The objective of this manuscript is to provide information about types, nutrition content, processing, and benefit as functional food of Indonesian local beans.

Type of Indonesia Local Beans

Various types of local beans can be found throughout the region of Indonesia. In this text, we will focus discuss four types of local beans in Indonesia, namely koro, mung bean, kerandang, and cowpea. Koro beans have many types (23 types), but those that are widely used as food are koro benguk (*Mucuna pruriens*), koro pedang (*Canavalia ensiformis*), koro glinding (*Phaseolus lunatus*) [5], as presented in Figure 1.

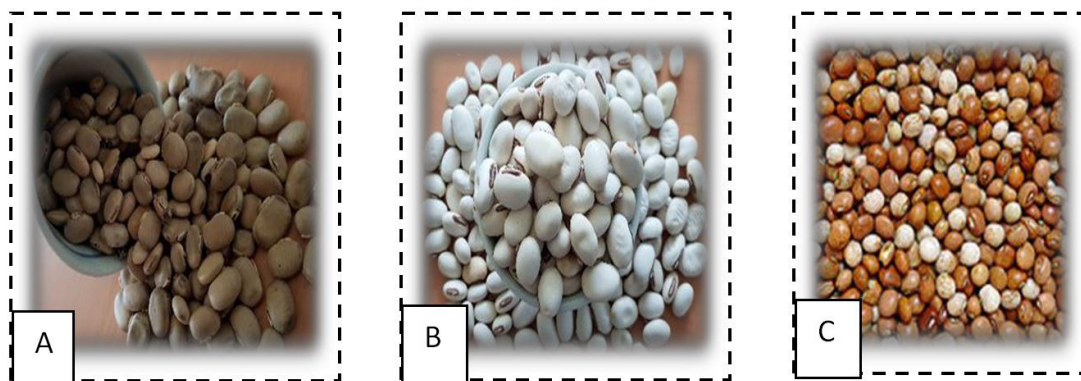


Figure 1: The types of koro beans, (a) koro benguk (b) koro pedang dan (c) koro glinding

The other local beans is mung beans (*Vigna radiata*), Figure 2. Mung beans can be found throughout Indonesia. This bean was third ranked after soybeans and peanuts in peanut development in Indonesia. The various varieties of mung beans have been produced by the Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture, including Vima 1, Vima 2, Vima 3, Vima 4 and Vima 5 [6].



Figure 2: (a) Mung bean plant (b) Mung beans

Kerandang (*Canavalia virosa*) and cowpea (*Vigna unguiculata*) are the other local beans that can be found in Indonesia. Kerandang plant can be found in the sand beach area of the island of Java. *Canavalia virosa* which found in coastal sand in Kulon Progo Regency and Bantul Regency, Yogyakarta Special Region, is call as Kerandang. Kerandang plants that grow wild along the sand beach of Yogyakarta have productivity of 909 to 1000 kg/ha. Kerandang produce pods measuring between 10-15cm, containing 4-8 seeds that are brown color, with a seed length of 14.3 mm and a width of 9.8 mm [7,8] as presented in Figure 3.

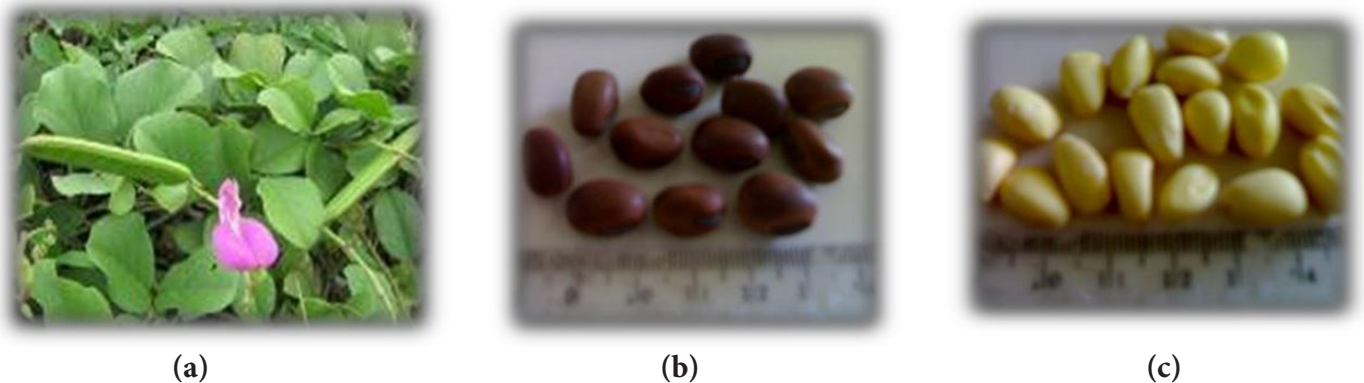


Figure 3: (a) Kerandang plant which grow in sand beach land, Yogyakarta; (b) Kerandang beans; (c) Peeled kerandang beans

Cowpea as one of the local bean types, there are two types of cowpea based on seed peel color, namely red and white cowpea (Figure 4). In Indonesia, cowpea is planted in various ecological zones from the lowlands to the highlands, dry climates to wet climates. Generally, cowpea is used as raw material for tempeh [4] and a mixture in traditional Javanese cuisine called *brongkos* and *gudeg krecek*.

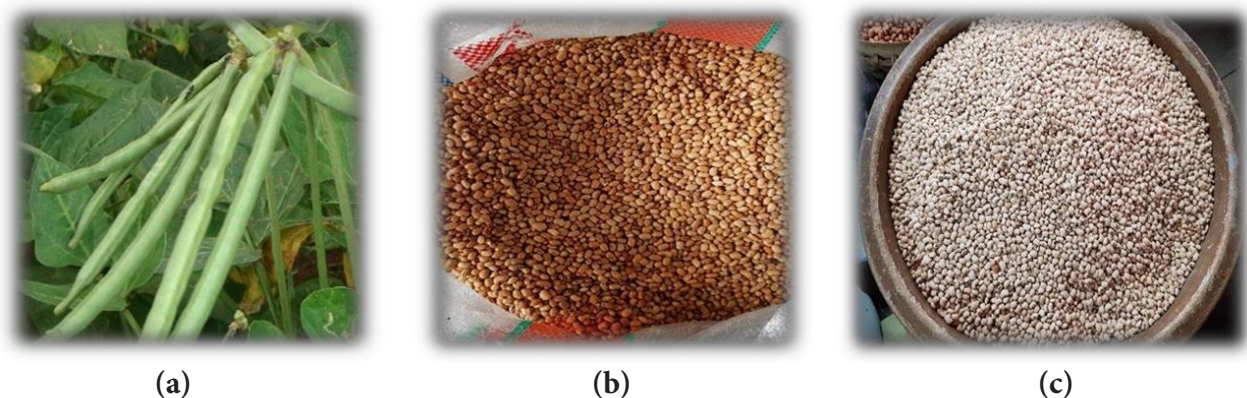


Figure 4: (a) Cowpea plant; (b) Red cowpea and (c) White cowpea

Nutritional Content of Indonesia Local Beans

Local beans belonging to leguminous plants produce pods and a source of protein. The nutritional content of kerandang, *koro pedang*, mung beans and cowpea are presented in Table 1. Water, ash fat and carbohydrates content (Table 1) shows statistically significant differences between Kerandang, *Koro pedang*, Mung bean, and Cowpea, except protein content between Mung bean and Cowpea not significant differences. Kerandang has the highest protein content among Indonesia local beans.

Component	<i>Kerandang</i> [8]	<i>Koro pedang</i> [9]	Mung bean [10]	Cowpea [11]
Water (%)	12,7 ^c	13,5 ^d	12,5 ^b	11 ^a
Ash (%)	2,8 ^b	2,3 ^a	-	-
Protein (%)	37,3 ^c	35,3 ^b	22,9 ^a	22,9 ^a
Fat (%)	1,3 ^c	1,6 ^d	1,2 ^b	1,1 ^a
Carbohydrate (by different) (%)	45,9 ^a	47,3 ^b	62,8 ^d	61,6 ^c

Table 1: Nutrition content of kerandang, koro pedang, mung bean, cowpea

Local beans also content minerals, such as calcium, sodium, potassium, phosphorus, magnesium, zink, mangannes, copper and iron. Also contain amino acid, such as glutamic acid aspartic acid, alanine, arginine, isoleucine, leucine, histidine, tyrosine and lysine. Several fatty acid also founded in local beans, such as palmitic acid, stearic acid, linoleic acid, oleic acid and linolenic acid [8, 9].

Indonesia Local Beans Product and Its Nutrition Content

Tempeh: Tempeh made from soybeans or the other local beans is authentic Indonesian food, centuries ago made on the island of Java, especially in Yogyakarta and Surakarta. In temporarily, Tempeh processed using local soybeans, given natural yeast from *waru* leaves or *jati* leaves and then wrapped with banana leaves so that it has a better taste.

Tempeh is one of the fermented beans technologies using pure culture *Rizopus* spp. or using tempeh starter which containing *Rhizopus oligosporus*, *Rizopus oryzae*, *Rizopus stolonifer* and *Klebsiella* [10]. Some lactic acid bacteria such as *Lactobacillus* spp., *Pediococcus* spp. and *Streptococcus* spp. plays an active role in the early stages of fermentation local beans into tempeh and has antimicrobial activity [11-13]. The presence of lactic acid produced by lactic acid bacteria will spurs *Rhizopus* spp. to grow.

Indonesia is known as the largest tempeh producer in the world. Tempeh production is not only in Indonesia but has worldwide such as in the United States, Canada, Mexico, Netherlands, Belgium, Australia and Africa [14]. Tempeh, generally consumed by the Indonesia people as a companion food for rice (*lauk*). Even now, tempeh has been developed from local beans in several regions in Indonesia, such as tempeh *koro benguk* in Yogyakarta, Central Java, East Java and South Sulawesi. Local bean tempeh products are presented in Figure 5. Local bean tempeh has good nutritional content, especially as a protein source. Local Bean Tempe also contains vitamins and minerals and even contains phenolic compounds that are good for the body health.

The local bean *koro pedang* has been used as raw material for tempeh processing. Tempe *koro pedang* has a protein content of 16.62%, 6.84% fat, 9.72% carbohydrate, dietary fiber 3.66% and brighter colors [15]. Tempeh kerandang has a brighter color than soybean tempeh and has a soft texture that is preferred by consumers. Kerandang tempeh has higher protein content (19.37%) than soybean tempeh (12.02%) and *koro benguk* tempeh (11.60%) [16] and contains essential amino acids and essential fatty acids which are good for the body health [17].



Figure 5: Local beans tempeh (a) koro benguk tempeh and (b) kerandang tempeh

Cowpea has been also used as raw material for processing tempeh. Cowpea tempeh has a protein content of 31.91%, 2.52% fat, 41.27% carbohydrate and crude fiber 10.66% [18]. Tempeh can also be processed from Mung beans. Mung bean tempeh has a vitamin E content of 8.83ppm with antioxidant activity of 210, 74 106 mg/L [19].

Tofu: The second product of local beans which quite popular in the community is tofu. Consumption of tofu in Indonesia is the same as tempeh, which is a companion food for rice (*lauk*). Mung beans Tofu is a form of product diversification from local beans. Mung bean tofu has been produced in several cities, namely in the Palu City (Central Sulawesi), Madiun (East Java) and Sumedang (West Java). Mung bean tofu contains 9.04% protein with a protein digestibility as large as 70,99% [20].

Cowpea is one type of local bean that is widely developed in almost all regions of Indonesia. Substitution of soybeans as much as 20% with cowpea, produce a high yield tofu (158.77%), liked by consumer and contains 9.19% protein [21] This cowpea tofu has been developed in Central Java, especially in Tegal District [22].

Koro pedang tofu has a protein content of 26.41%, 2% fat, 26.06% carbohydrate and can be accepted by consumers [21,23]. The use of *kerandang* beans to substitute soybeans for tofu processing reaches 50% and the tofu produced has a protein content of 13.69%; 3.40% fat and 0.25% crude fiber and preferred by consumers [8].

Non-dairy Milk: Non-dairy milk is one form of local bean diversification products. Non-dairy milk processing is very simple and can be done on a household scale. As well as with soy milk, local bean milk is obtained by soaking and boiling of beans and then milled with the addition of water at a certain concentration and filtered to produce non-dairy milk [24,25]. Based on the research that has been done, non-dairy milk made from *koro pedang* beans (*Canavalia ensiformis*) has good functional value. Consumption of 9g of *koro pedang* milk can reduce cholesterol levels by 33.54% and serum triglyceride levels by 40.9% in hypercholesterolemia mice [26].

In the processing of household scale local powdered milk, local bean non-dairy milk is heated then added sugar and heating is continued until it becomes crystalline. Then milling is carried out until milk powder is obtained. While processing local bean powder milk in large industries can be done using equipment such as spray dryers, freeze dryers or dryer drums [27].

The processing of *kerandang* non-dairy milk powder using a spray dryer contain dissolved proteins in the amount of 16.08% - 23.86%, phenolic compounds of 1.33% - 7.55%, isoflavones genistein of 0.45 g / 100 g to 0, 61 g / 100g of milk powder and have antioxidant activity and are soluble at various pH (acidity levels) [24]. Thus, it can be said that *kerandang* non-dairy milk powder is safe for consumption and has functional value.

Non-dairy Milk Fermentation: The use of lactic acid bacteria in fermented beverages starts from the fermentation of mammalian milk to produce a product known as yogurt and kefir [28,29] But now a days, the use of lactic acid bacteria to produce fermented beverages is increasingly widespread, especially the use of lactic acid bacteria in the fermentation of local beans milk to produce a product called non-dairy milk fermentation [30-32]. The use of lactic acid bacteria provides benefits because these bacteria can suppress the growth of fungi and harmful bacteria, making food become longlife [33,34].

Lactic acid bacteria *Lactobacillus plantarum-pentosus* indigenous isolated from tempeh was produce β -glukosidase enzyme [33,35] Which can hydrolysis the isoflavones daizine and genistine into isoflavones daizein and genistein so antioxidant activity of *kerandang* non-dairy milk fermentation is increase and has anticancer properties [1,36]. These bacteria can also degradation of raffinose into saccharide such as sucrose, glucose, fructose and galactose [37] so the *kerandang* non-dairy milk fermentation easier to digest and does not cause flatulence.

Kerandang (*Canavalia virosa*) seeds contain antrinitrient factors (ANF) such as phytic acid (1.1%), tannin (5.8%), L-DOPA (4.3%) and cyanide acid (0.013%) which are toxic, concaivalin A, canavavin and canavalin [38,39]. However, antinutrients and toxic properties are not resistant to heat [38]. According to Djaafar et al. [40], *Kerandang* also contain HCN which is quite high (1133.9ppm) but with immersion for 48 hours (with water change every 6 hours) before processing can reduce HCN content to 16.8 ppm. In addition, the processing of tempeh and tofu cages decreased HCN content by 97.6% and 86.8% respectively [8,41].

Product	Beans	Nutrition	Benefit	References
Tempeh	Koro pedang	Protein (16.62%) Fat (6,84%) Carbohydrate (9.72%) Diaterly fiber (3.66%)	Antioxidant activity, good protein source, good for body health	[15,16,18,19]
	Kerandang	Protein (19.37%)		
	Koro benguk	Protein (11.60%) Essential amino acids Essential fatty acids.		
	Cowpea	Protein (31.91%)		
		Fat (2.52%) Carbohydrate (41.27%) Crude fiber (10.66%)		
Mung bean	Vitamin E content of 8.83 ppm.			

Product	Beans	Nutrition	Benefit	References
Tofu	Koro pedang	Protein (26.41%) Fat (2%) Carbohydrate (26.06%)	Antioxidant activity	[8,22-24]
	Kerandang (50%) Soybeans (50%)	Protein (13.69%) Fat (3.40%) Crude fiber (0.25%)		
Non-dairy Milk	Koropedang		Reduce cholesterol levels and serum triglyceride	[26]
	Kerandang	Proteins (16.08% - 23.86%) Phenolic (1.33% - 7.55%) Isoflavones genistein of 0.45g/ 100g to 0, 61g/ 100g of milk powder	Antioxidant activity	[24]
Non-dairy fermented Milk	Kerandang	Isoflavones daizein and genistein	Antioxidant activity and anticancer properties	[1,36]

Table 2: Products, nutrition and benefits of Indonesia local beans

Conclusion

Indonesia as an agricultural country has natural wealth as a food source. Local beans in Indonesia are very diverse and have the potential to be a nutritious food source. Local beans can be processed into various foods such as tempeh, tofu and non-dairy milk which are rich in nutrients and functional because they contain the amino acid, fatty acid, vitamins, minerals, and isoflavones.

References

- Djaafar TE, Sugahara T, Rahayu ES, Cahyanto MN, Santoso U, et al. (2015) Isoflavone changes during fermentation of kerandang (*canavalia virosa*) milk using *lactobacillus plantarum*-*pentosus* and its anticancer activity. *Kasetsart J Nat Sci* 49: 441-50.
- Hudiyanti DWI, Arya AP, Siahaan P, Suyati L (2015) Chemical composition and Phospholipids Content of Indonesian Jack Bean (*Canavalia ensiformis* L.) . *Oriental J Chem* 31.
- Ekafitri R, Isworo R (2014) Utilization of Nuts as a Raw Material for Protein Sources for Emergency Food. *Food* 23: 134-45.
- Haliza W, Purwani EY, Thahir R (2016) Utilization of Local Beans as a Substitution. *Agric Postharvest Technol Bulletin* 3:1-9.
- Effect of Heating Technique on Fitat Acid Levels and Antioxidant Activities of Koro Benguk (*Mucuna pruriens*), Glucose Koro (*Phaseolus lunatus*) and Koro Sword (*Canavalia ensiformis*). *Essay Faculty of Agriculture, Sebelas Maret University, Surakarta.* (in Indonesia)
- Agricultural Research Agency. Characteristics of new superior varieties of green beans (2017).
- Eke CNU, Asoegwu SN, Nwandikom GI (2007) Some physical properties of Jackbean seed (*Canavalia ensiformis*). *Agric Eng Int: CIGR Ejournal Manuscript FP 07 014*, vol IX.
- Djaafar TE, Cahyaningrum N, Purwaningsih (2010) Physico-chemical characteristics of tribal beans (*Canavalia virosa*) and its alternative tofu and tempeh food products. *Int J Agri Sci* 11: 74-80.
- Agbede JO, Aletor VA (2005) Studies of the chemical composition and protein quality evaluation of differently processed *Canavalia ensiformis* and *Mucuna pruriens* seed flours. *J Food Compos Anal* 18: 89-103.
- Nurrahman, Astuti M, Suparmo, Soesatyo MHNE (2012) Fungal growth, organoleptic properties and antioxidant activity of black soybean tempe produced with various types of inoculum. *Agritech J Agric Technol* 32: 60-6.
- Rahayu ES, Djaafar TE, Wibowo Dj, Sudarmadji S (1996) Lactic acid bacteria from indigenous fermented foods and their antimicrobial activity. *Indonesian Food Nutr Prog* 3.
- Djaafar TE, Rahayu ES, Wibowo Dj, Sudarmadji S (1996) Antimicrobial substances of lactic acid bacteria isolated from traditional Indonesian fermented foods. *J Indonesian Agric Sci* 6.
- Djaafar TE, Rahayu ES, Wibowo Dj, Sudarmadji S (1996) Antimicrobial substance produced by *Lactobacillus* sp. TGR2 isolated from growol. *Indonesian Food Nutr Prog* 3.
- National Standardization Agency (2012) *Tempe: Indonesian Offering to the World*. Jakarta.
- Diniyah N, Windrati WS, Maryanto, Purnomo BH, Wardani W (2014) The characteristics of the sword koro tempe (*Canavalia ensiformis* L.) are made with variations in the percentage of yeast and type of packaging. *News Agric Prod Ind* 31: 1-10.
- Cahyaningrum N, Djaafar TE, Marwati T (2016) The physicochemical characteristics of kerandang tempe as an alternative food. *Proc National Semin Food Agric Prod, PATPI Yogyakarta*
- Djaafar TE, Cahyaningrum N, Marwati T (2018) The potential of local beans as raw material for tempeh and its chemical characteristics. Paper presented at the National Seminar on "Downstreaming Strategies for Research Results to Increase Nation Competitiveness in the Era of Industrial Revolution 4.0", November 24, 2018 at the University of Slamet Riyadi, Solo.
- Ratnaningsih N, Nugraheni M, Rahmawati F (2009) Effect of tolo bean type, manufacturing process and type of inoculum on changes in nutrients in fermented soybean tempeh. *Saintek Res J* 14: 97-128.
- Maryam S (2015) Potential of fermented tempeh (*Vigna radiate* L.) using traditional inoculum as functional food. *Sci Technol J* 4: 639-46.

20. Karti E, Rosida (2009) Overview of nutrition of tofu and tempeh gembus from several types of beans as an alternative substitute for soybeans. Paper presented at the National Seminar on the Role of Information Technology in the Field of Food, Chemical and Manufacturing Technology in Supporting Development.
21. Hardiyanti Q (2011) Study of the quality of tofu from cowpea and soybeans. Essay; Faculty of Industry, National Veteran Development University, Surabaya.
22. Ilahiyah I, Mulyati S, Ningsih IS, Nindhita LN, Sari RR (2017) Tahu nikah (Nigari red beans) as a form of diversification of environmentally friendly healthy foods. *J Creativity Student* 2: 26-33.
23. Widiantera T, Cahyadi W, Razak I L (2017) Utilization of sword beans (*Canavalia ensiformis* L.) on the making of koro bean based on differences in concentration of coagulants. *Pasundan Food Technol J* 4: 182-90.
24. Djaafar T F, Santoso U, Ariestyanta A. (2017). Effect of addition of maltodextrin and inlet spray dryer temperature on the physicochemical characteristics of cider extract powder (*Canavalia virosa*). *AGRITTECH J Agric Technol* 37: 334-42.
25. Djaafar TF, Santoso U, Rahayu ES, Cahyanto MN (2017) Kerandang (*Canavalia virosa*) seed as raw material for non-dairy milk: the effect of soaking and boiling on physics chemical characteristic. *Proceeding Int Conf Food Sci Nutr*.
26. Primawesti MA (2014) The effect of giving swords koro milk (*Canavalia ensiformis*) to total cholesterol and triglyceride levels of Sprague Dawley hypercholesterolemic rats. *Research Article, Nutrition Science Study Program, Faculty of Medicine, Diponegoro University Semarang*.
27. Djaafar TF (2017) *The Potency of Kerandang as Food*. Penerbit Global Pustaka Utama Yogyakarta.
28. Djaafar TF, Rahayu S (1999) Making yogurt with *Lactobacillus* inoculum isolated from traditional fermented foods. *Proceedings Food National Semin*.
29. Mayo B, Aleksandrak - Piekarczyk T, Fern á ndez M, Kowalczyk M, Ivarez - Mart í n P Á and Bardowski J, (2010) Updates in the Metabolism of Lactic Acid Bacteria in Biotechnology of Lactic Acid Bacteria; Novel Application. A John Wiley & Sons, Inc., Publication, IOWA, USA.
30. Djaafar TF, Rahayu S (2006) Characterization of yogurt with *Lactobacillus* inoculum isolated from traditional fermented foods. *AGROS Sci J Agric Sci* 8.
31. Wanita YP, Djaafar TF, Purwaningsih (2011) Technology development of cage yogurt (*Canavalia virosa*) and analysis of its business. *J Assess Dev Agric Technol* 14: 151-9.
32. Giyarto, Djaafar TF, Rahayu ES, Utami T (2011) Fermentation of peanut milk by *Lactobacillus acidophilus* SNP-2 for production of non-dairy probiotic drink. *Proceeding 3rd Int Conf Indonesia Society Lactic Acid Bacteria*, 2011.
33. Marwati T, Khusna RNB, Djaafar TF, Rahayu ES (2017) Inhibition Growth of Mycotoxin Producing Fungi by Lactic Acid Bacteria Isolated from Fermented Cocoa Bean (*Theobroma cacao* L.) in Indonesia. *Proceedings 15th ASEAN Conf Food Sci Technol* 14-7.
34. Djaafar TF, Rahayu S, Rahayu ES, Okada S (1996) Lactic acid bacteria and antimicrobial activity. *Proceedings National Food Nutr Semin*.
35. Djaafar TF, Miyashita M, Cahyanto MN, Santoso U, Rahayu ES, Suhartati N. (2013). Indigenous lactic acid bacteria from Indonesia Fermented food and its production of β -glucosidase. *Proceeding 7th Asean Conf Lactic Acid Bacteria*.
36. Djaafar TF, Santoso U, Cahyanto MN, Sugahara T, Rahayu ES, Nishi K. (2013). Effect of indigenous lactic acid bacteria on enrichment of isoflavone and antioxidant properties of kerandang (*Canavalia virosa*) extract. *Int Food Res J* 20: 2945-50.
37. Djaafar TF, Cahyanto MN, Santoso U, Rahayu ES (2013) Growth of indigenous lactic acid bacteria *Lactobacillus plantarum*-pentosus T14 and *Lactobacillus plantarum*-pentosus T35 in kerandang (*Canavalia virosa*) milk and changes of raffinose. *Malaysian J Microbiol* 9: 213-8.
38. Thangadurai D, Viswanathn N, Ramesh (2001) The chemical composition and nutritional evaluation of *Canavalia virosa*: a wild perennial bean from Eastern Ghats of Peninsular India. *Eur Food Res Technol* 213: 456-9.
39. Thangadurai D, Viswanathn N, Ramesh (2001) The chemical composition and nutritional evaluation of *Canavalia virosa*: a wild perennial bean from Eastern Ghats of Peninsular India. *Eur Food Res Technol* 213: 456-9.
40. Djaafar TF, Purwaningsih RS (2009) The study of the processing technology of sweet potatoes into composite paste and flour and cage seeds supports alternative food development in the Special Region of Yogyakarta. *Report of RISTEK 2009 Research Activities, BPTP Yogyakarta*.
41. Djaafar T, Wanita YP, Rahayu ES, Cahyanto MN (2011) Novel product, fermented drink from kerandang (*Canavalia virosa*). Paper presented at The 12th Asian Food Conference 2011, 16-18 June 2011, BITEC, Bangna, Bangkok, Thailand.