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## The Evaluation of Nutritional Value of Rendang Minangkabau

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### Abstract

Rendang is a traditional Minangkabau food which voted by CNN viewers in 2011 as one of the most delicious foods in the world. The basic ingredients of rendang are beef meat, coconut milk and spices. The process of cooking rendang took around 6 to 7 hours at the temperature around 80-95 °C. There are 3 types of food will be produce during the cooking processes differentiated by water content and colors. They are as following: gulai (cooked until the sauce became thin and yellowish), kalio (cooked until the sauce was thick brown color) and rendang (cooked until the sauce was thick and dry and dark brown color). As the food is cooked in a relatively longer period of time and with various ingredients it is interesting to know the nutritional value of the food. This paper is presenting a preliminary results of the research which aim to evaluate the nutritional value of rendang by analyzing the chemistry compositions, protein digestibility (in-vitro), the profile of amino acid (HPLC), and measuring molecule weight of protein (SDS-PAGE). The result shown that the protein in rendang is decreased compare to fresh meat and kalio. The protein digestibility decreased in rendang compare to fresh meat and kalio and the amino acid content is decreased in rendang compare to fresh meat and kalio. The protein band is increased from fresh meat to kalio and rendang, where in fresh meat have 15 protein bands, 16 in kalio and 17 in rendang.

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**Keywords:** kalio., rendang., protein digestibility., amino acid profile., protein bands

### 1. Introduction

Rendang is a traditional food of Minangkabau ethnic in West Sumatra which is cooked by using heat from fire wood. The process of cooking rendang take around 6 - 7 hours, with temperature hanging around 80 - 90 °C, until the meat turn soft and tender and the color tum to dark brown or black and give specific flavor and aroma.

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The purpose of such kind of cooking processes is to convert the raw material of food into edible foods and to prolong the storage life of rendang. There are 3 types of food will be produce during the cooking processes differentiated by water content and colors. They are as following: gulai (cooked until the sauce became thin and yellowish), kalio (cooked until the sauce was thick brown color) and rendang (cooked until the sauce was thick and dry and dark brown color). As the food is cooked in a relatively longer period of time and with various ingredients it is interesting to know the nutritional value of the food.

Food processing, in general, can alter nutritional components both in positive and negative ways. The positive alteration are in the form of improved the protein digestibility, increased in availability of nutritive components, and decreased anti-nutrition component in raw material. On the other hand, the negative alteration decreased nutritive components because their sensitivity to pH, heat, oxygen, light and combination of them. The micro nutritive component especially copper, ferrum and enzyme can be a catalyst in the process (Palupi et al., 2007). The nutritive value of protein depends on the amount or number of amino acids essential and the digestibility of the protein in the food.

The basic ingredient of rendang is meat and coconut milk which is rich in protein and fat. These components can change in physical and chemical structure while cooking process. Heating the protein can cause the denaturation of protein, deamination, hydrolysis, desulfurization, rasemisation, change of the color, derivation of the amino acid, cross linking, and loss activity of enzyme. Most of the reaction is irreversible and some of the reaction will produce the toxic component. But in other ways inactivation of the enzyme by heat such as protease, lipase, lip-oxygenise, amylase, oxidative enzyme and hydrolytic enzyme can protect the food material from off flavor.

The macro component in the food always come together such as protein, fat, carbohydrate, so the processing effect can be happen by the reaction of them such as reaction between amino acid from protein and reduction sugar from carbohydrate or with carbonyl or aldehyde component (the result of fat oxidation) as called Maillard reaction.

Maillard reaction is one of the most important reaction which result from food processing and will influence essential foods quality attribute such as a flavor, aroma, color and texture (Markowitz et al., 2012). In the other ways Maillard reaction result melanoidin component can decrease the digestibility of protein. The decrease of digestibility can be happen because of the damage of some amino acid essential such as lysine and cysteine by reaction with carbonyl. The Maillard product can reduce the availability of amino acid include leucine (the most stabile amino acid) because of cross linkage reaction between amino acid. In other ways the decrease of protein digestibility can be happen because the cross-linkage can inhibited the substrate to come to enzyme in the active site area (Muchtadi, 2008).

Because rendang have been consumption since late year in Minangkabau and now all people over the world eat rendang, but no yet scientific research report about rendang. The report finds just popular writing but not yet scientific research, so it is really necessary to do research about rendang Minangkabau. This research aim to evaluation of nutritional value and characteristic of aromatic component so can give information to consumer, producer and for development of the knowledge. This paper will report the preliminary result about the nutritive value of protein rendang.

## 2. Material and Methods

### 2.1. Basic material

The basic material are the beef tenderloin, coconut milk from the mature coconut, spices such as red chili, onion, garlic, ginger, galangal, coriander, nutmeg, clove, white pepper, caraway, cardamom, lemon grass, turmeric leaf, lime leaf, and bay leaf.

The equipment need: equipment for cooking rendang, HPLC (high performance Liquid Chromatography), electrophoresis SDS-PAGE (Sodium Dodecyl Sulphate Polycrylamide Gel Electrophoresis), oven, analytic weight, kjedhal, Erlenmeyer, filter, equipment for digestibility test and others. This research does in faculty of technology agricultural Andalas University laboratories, Laboratories Faculty of Animal husbandry IPB Bogor, Laboratories Faculty of GMSK IPB Bogor and Laboratories Saraswanti Indo Genetech Bogor.

## 2.2. Cooking process of rendang

All of the spices grounded except galangal and leafs and mix together with coconut milk and then heat in temperature around 90 - 93°C and 90 minute until the sauce is thick. Put the meat in to the sauce and keep in the heat in temperature around 90 - 93°C and 90 minute until the sauce more thick and the color change brown, this product named Kalio. Continue the process but decrease the temperature into 80-83°C, it will take 2 hours until the product dry and the color change to dark brown or black, this product named rendang. While cooking time the product needs to steer regularly to protect from burn.

## 2.3. Analysis of Product

Before analyzed rendang separated into 3 components, they are <sup>1</sup>meat, sauce and oil. In this paper we will report just for the meat of rendang. Fresh meat, Kalio meat and Rendang meat were analyzed the chemistry composition such as water content, protein, fat, ash dan carbohydrate by different. The protein digestibility (in-vitro), amino acid content (HPLC (high performance Liquid Chromatography) and protein molecule weight with electrophoresis SDS-PAGE (Sodium Dodecyl Sulphate Polycrylamide Gel Electrophoresis).

## 3. Result and discussion

### 3.1. Chemical composition

Rendang was cooked for 6 hours and temperature around 80 - 93°C, furthermore the end of cooking process indicated by change of the meat color and sauce, and the meat turn to soft and tender. The chemical composition of meat rendang was separately analyzed from the sauce of rendang. The result of chemistry composition analysis of fresh meat, kalio meat and rendang meat are expressed in dry basic moisture content (db) show in Table 1.

Table 1. Water content, protein, fat, ash and carbohydrate by different of fresh met, kalio meat and rendang meat (dry basic)

Composition	Fresh meat (% db)	Kalio meat (% db)	Rendang meat (% db)
Water content <sup>2</sup>	72.57 a	46.43 b	29.87 c
Protein <sup>2</sup>	81.15 a	62.93 b	59.67 b
Fat <sup>2</sup>	3.46 a	16.35 b	21.10 c
Ash <sup>2</sup>	4.22 a	4.63 b	5.13 c
Carbohydrate (by different) <sup>2</sup>	11.17 a	16.09 b	14.10 c

<sup>2</sup> Similar letter in the each row indicate no significant differences were observed

Moisture content of the meat kalio and rendang are decrease significantly because the process of cooking rendang take along time around 6 hours, but in apposite way fat and ash were increase. The protein in kalio and rendang are decrease while cooking process because the heat will make the structure of the tissue meat enlarge and longer and bring out the water with some of the soluble protein. Kasir (1999) said that if beef protein boiled in the temperature around 65 - 70°C in 20 minutes can make the soluble protein will get out and solve in the boiling water.

The decrease of protein is also because the increase of fat in the meat where the increase of fat in kalio meat and rendang meat may be added from coconut milk, because when the water out from the tissue the fat from coconut milk will get inside so make the fat increase. Seow & Gwee (1977) say that coconut milk where extract without water have fat 32 - 40%, protein 2,6 - 4,4 % and water 50 - 54%.

### 3.2. Protein digestibility

Digestibility of protein is a capability of protein enzyme to hydrolyze the protein becomes small unit such as amino acid (Muchtadi, 1993). Digestibility of protein can be say as the percentage of protein can digested by enzymes so can be absorb through the intestine mucosa. Digested protein is proteins that can be absorb in 100 g of food, or percentage of protein digestibility times concentration of protein in food. The protein digestibility and digested protein on some type of meat shows in Table 2.

Table 2. The protein digestibility and digested protein on fresh meat, kalio meat and rendang meat.

Composition	(Protein digestibility% wb) <sup>2</sup>	Digested protein (% wb) <sup>2</sup>
Fresh meat	74.59 a	16.60 a
Kalio meat	73.14 b	24.66 b
Rendang meat	71.80 c	30.05 c

<sup>2</sup> Similar letter in the each column indicate no significant differences were observed

The result show that cooking processing of rendang decrease of protein digestibility from fresh meat, kalio meat and rendang meat, this is because the heat while cooking will activating chemistry reaction in the meat such as hydrolysis, changing the conformation of protein structure, denaturation, Maillard reaction, cross linkage and other protein reaction. That reaction some of them can effect to increase the protein digestibility and some of them can decrease the protein digestibility.

Hydrolysis reaction can make the amino acid will free from polypeptide chain so easy for intestine mucosa to absorb them. Palupi (2007) said, while food processing will increase the protein nutritional and the availability of nutritional in food because of the free of amino acid, so make easy for intestine mucosa to absorb the amino acid.

Maillard reaction produces flavor and aroma during cooking process and it is used almost everywhere from the baking industry to our day-to-day life to make the food tasty. When food are being processed or cooked at high temperature, chemical reaction between amino acids and reducing sugars are lead to the formation of melanoidines or Maillard Reaction Products (MRPs) (Tamana & Mamood, 2015).

Maillard Reaction Products or melaniodine component decrease in protein quality due to the loss of amino acids residues and can inhibited the protein digestibility (Dills, 1993).

Some of the amino acid such as Lysine (with epsilon-amino), Methionine and Cystein (with sulfur component) can easy to reaction with polyphenol component so will result sulfokside component. The sulfokside component cannot be absorbed by intestine mucosa so will decrease the protein digestibility. In other ways although the protein digestibility are decrease but the protein digested will increase in Kalio and Rendang because the increase of percentage of protein in 100 g in meat (wet basic).

Muchtadi (2010) explained that heat can cause reaction between protein and reduction sugar that can make browning pigment (melanoidine) who suspect make the protein digestibility decrease. Furthermore Miller et al. (1965), said in Maillard reaction some of the amino acid will be broken because they will react with dicarbonil and aldehyde or say as cross-linkage reaction. These component cannot be able to hydrolyze by protease enzyme so will decrease the protein digestibility.

Muchtadi et al. (1992), says while heating process protein and lipid can reacted, some of amino acid will react to each other and change of structure conformation of amino acid from L to D (racemation) where all of them can't hydrolyze by protein enzyme so will decrease the protein digestibility. Hurrell et al (1984) says that methionine sulfokside can not used as a good as nature methionine in rat experience metabolism.



### 3.3. Amino Acid Profile

HPLC (*high performance Liquid Chromatography*) result for amino acid composition fresh meat, kalio meat and rendang meat shows in Table 3. From the HPLC analysis shows that concentration of all amino acid decrease from fresh to kalio and rendang meat, but some of them quite stable such as leucine, proline, glutamine and histidine. The most unstable amino acid is tyrosine, phenylalanine and tryptophan. In general the decrease of concentration from fresh meat to kalio is around 6.31% and from kalio to rendang meat are around 6,20 %. The essential amino acid such as Hys, Ilo, Leu, Lys, Met, Phe, thr, Tyr, and Trp were decrease around 17.55%.

The heating process while cooking where the temperature around 83 - 93°C and 6 hours caused some reaction in the amino acid such as hydrolysis, cross-linkage and browning reaction or Maillard reaction. The amino acid cant reacted with carbohydrate in low temperature but in high temperature carbohydrate will hydrolyze become monosacharyde so the Maillard reaction will active.

Table 3. Concentration of amino acid from fresh meat, kalio meat and rendang meat (%)

Amino acid	Fresh meat (% db)	Kalio meat (% db)	Rendang meat (% db)
L-aspartic acid	3.56	3.29	3.05
L-serine	3.83	3.06	3.20
L-glutamic acid	5.79	5.62	5.38
Glycine	4.33	3.61	3.53
L-histidine	3.13	2.49	2.72
L-arginine	5.22	3.98	3.79
L-threonine	5.27	3.93	3.90
L-alanine	6.08	5.24	5.37
L-proline	1.71	1.66	1.65
L-tyrosine	3.37	2.47	2.28
L-valine	7.70	7.80	6.16
L-methionine	3.44	3.18	3.10
L-lycine HCl	5.62	5.36	4.63
L-isoleucine	8.53	8.24	7.20
L-leucine	15.39	15.62	15.38
L-phenylalanine	12.83	9.53	8.45
L-tryptophan	0.764	0.45	0.44

### 3.4. Protein molecule weight

Figure of protein bands by electrophoreses SDS-PAGE method with molecule weight basic of fresh meat, kalio meat and rendang meat show in Figure 1.

The result show that the protein band increase from 15 bands in fresh meat, become 16 in kalio meat and 17 in rendang meat. The increase of protein band, because of the long period process in high temperature (63 - 93°C, 6 hours) brake the polypeptide chain and make a new polypeptide with lower molecule weight.

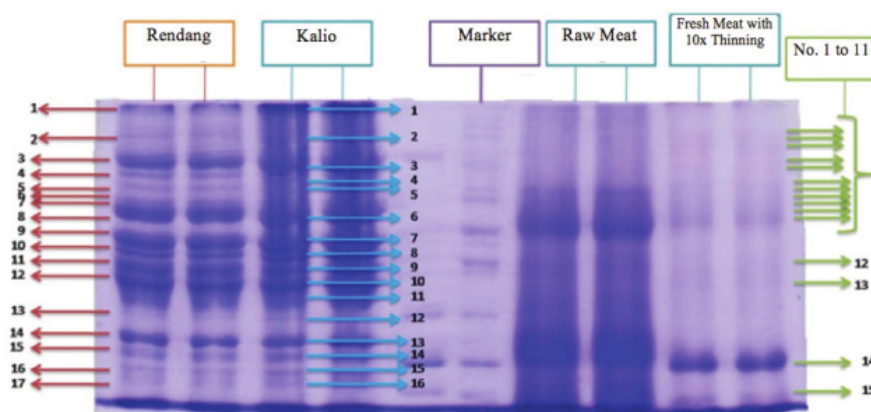


Figure 1. The band of protein molecule weight from electrophoresis with SDS-PAGE method of fresh meat, kalio meat and rendang meat.

#### 4 Conclusion

1. Protein concentration in rendang meat decrease compare to fresh meat and kalio meat (db)
2. Protein digestibility in rendang meat decrease compare to fresh meat and kalio meat, where in fresh meat 74,59, in kalio meat 73,14 and 71,80 in rendang meat.
3. The decrease of amino acid concentration from fresh meat to kalio is around 11.42% and from kalio to rendang meat are around 6,20 %.
4. Protein band in rendang meat increase compare to fresh and kalio meat, they are 15 bands in fresh meat, 16 bands in kalio meat and 17 bands in rendang meat.

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