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Nutrient characteristic of vacuum fried-dendeng lambok

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Abstract. The nutritional characteristics of the beef on the production of vacuum fried *dendeng lambok* as a specific traditional food at West Sumatera, Indonesia was evaluated. The nutritional properties such as amino acids, fatty acids and in-vitro protein digestibility of the vacuum fried *dendeng lambok* was compared with the conventional frying process. As the result, there was a difference on the nutritional characteristics between vacuum fried *dendeng lambok* and conventional fried *dendeng lambok*. All parameters such as amino acids, fatty acids and of vacuum fried *dendeng lambok* in-vitro protein digestibility of the vacuum fried *dendeng lambok* indicated the higher value compared to conventional fried *dendeng lambok*. It can be suggested that the utilization of vacuum frying process could increase the nutritional value of fried dendeng lambok.

Keywords: dendeng lambok, frying process,nutritional changes, specific spices.

1. Introduction

Food diversification has been identified as one of the most important industries in Indonesia for developing tourism consumers with a particular need for specific traditional food [1, 2]. *Dendeng* is a type of traditional Indonesian dish associated with the Minang Kabau district of West Sumatra province. *Dendeng* is a thinly sliced dried meat that is kept by a combination of special spices and then dried by frying. Coriander, garlic, galangal, pepper, tamarind, cinnamon, cumin, and lime are the most common spices used in the preparation of dendeng [3]. These spices have been found to have health benefits in addition to their use as organoleptic enhancers in cooking [4].

Dendeng is classified into two varieties based on the processing method: *dendeng lambok* (moist beef jerky) and *dendeng kering* (dried beef jerky) [5]. Dendeng lambok is a type of dendeng made from raw beef that has been cooked with seasonings before being pounded flat and fried. Dendeng kariang, on the other hand, is made from rawly sliced beef that is seasoned with spices without boiling, then dried in the sun until it reaches a specified moisture level before being fried. As a result of the method of integrating spices into the processed beef, dendeng lambok has a more distinct flavor and has grown more famous than dendeng kariang.

Dendeng lambok has been the subject of numerous studies. To achieve better color, flavor, aroma, and texture, *dendeng lambok* is fried[5]. Generally, the utilization of conventional drying is used in the production of *dendeng lambok*. Therefore, the comparation of the protein profile, amino acid profile, and fatty acid profile of dendeng lambok fried with conventional high-temperature frying to dendeng

lambok fried with vacuum frying has pointed in this study. The findings of this study could provide more information about the nutritional content of vacuum fried dendeng kariang, as well as show that vacuum frying is an alternative approach for manufacturing healthier foods. The findings of this study will also back up data on the widespread use of vacuum frying technology in maintaining the quality of fried food products.

2. Materials and methods

2.1 Materials

The raw cow beef used in dendeng lambok, as well as the spices, were acquired in a local market and kept at a temperature of 6 ±1°C until they were delivered to the laboratory for processing and analysis.

2.2 The preparation of dendeng lambok

The raw beef chopped into 3cm x 4cm x 1cm cubes, cooked for 30 minutes with spices. The spiced meat was then beaten till it was 6cm x 4cm x 2mm in size. Furthermore, the flat beef is cooked in a certain manner. Vegetable oil was used in the frying procedure. For the conventional frying method, it is fried for 5 minutes at 175°C, and for the vacuum frying method, it is fried for 20 minutes at 95 °C and 12 mmHg pressure.

2.3 Proximate analysis

The proximate parameters were determined by AOAC methods (Association of Official Analytical Chemists, 2010) [6]. By subtracting the total percentage of the other parts from 100, the carbohydrate content was computed.

2.4 Amino acid analysis

Dendeng lambok were hydrolyzed during 24 hours at 110°C with 25 mL of a 6N HCl solution. The AccQ.TagTM approach was used to determine amino acids using a Waters UPLC System [7].

2.5 Fatty acid analysis

Folch's approach was used to remove the residual lipid in the samples. The analytical procedure was used as described by some previous studies [8, 9, 10].

2.6 In-vitro protein digetibility

The method of Akeson and Stahmanna [11] was used to determine in vitro protein digestibility. One gram of sample was added to 15 ml of 0.1 M HCl, which included 1.5 mg of pepsin, and incubated at 37°C for 3 hours. The resulting suspension was neutralized with NaOH (7.5 ml, 0.2 M) before being treated with 4 mg pancreatin in 7.5 ml phosphate buffer (0.2 M) (pH 8.0). To prevent microbial development, one milliliter of toluene was added, and mix the mixture gently and incubated for 24 h at 37°C. After incubation, samples were centrifuged at 50000g for 20 min at room temperature with 10 ml of 10% TCA to remove undigested protein and larger peptides. The Kjeldahl method[6] was used to calculate the amount of protein in the supernatant. The ratio of protein in the supernatant to protein in the sample is used to estimate the percentage of protein digestibility, as reported by Afify et al [12].

2.7 Statistical analysis

For the analytical data, mean values and standard deviation are reported. The data obtained were subjected to one way analysis of variance (ANOVA) and least significant difference (LSD) at $P<0.05$.

3. Results and Discussion

3.1 Proximate Analyses

The result of the proximate analyzes in the fresh meat and fried meat including vacuum fried dendeng lambok and conventional fried dendeng lambok is represented in Fig.1. The water content in each treatment had higher levels when compared to other parameters (fat, protein, ash and carbohydrates). After the frying process, the water content in each frying treatment for *dendeng lambok* decreased, while the fat content, protein content and ash content increased. Water content decreased after the frying process. the results can be seen that the water content with vacuum frying is higher than conventional frying. These were in agreement with the results observed by Fang et al., (2020) vacuum frying worked at a lower temperature of 120 °C showed slow dehydration during first 4 min and reached around 4.1% wb in 16 min. The frying time of 24 min (moisture 3.0% wb) was regarded as the final of product processing.

Fat content has also increased. Budžaki & eruga; Krokida et al [13,14] reported that frying is a process that involves simultaneous heat and mass transfer, where cooking oil is the medium of heat transfer into the food, while moisture migrates out and the oil is absorbed into the food.

The protein content in *dendeng lambok* were increased. Vacuum frying has a higher protein content than conventional fryers. Frying using vacuum frying causes the quality of the fried ingredients to be maintained, especially protein because it uses low temperature and pressure [15].

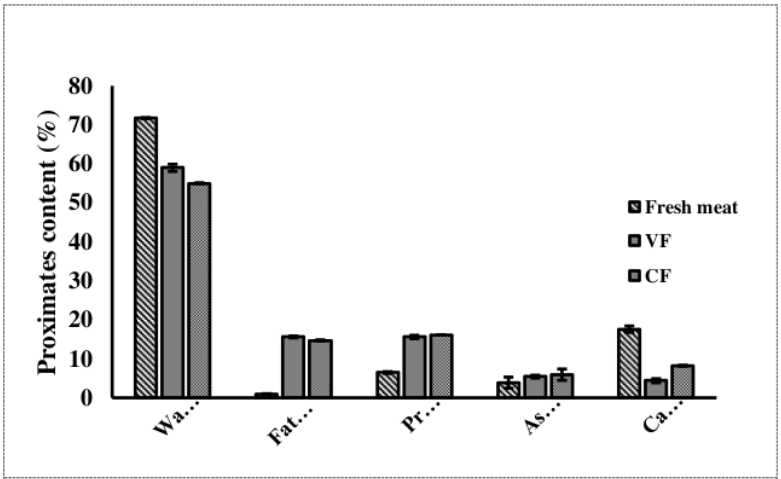

Figure 1. Water content, fat, protein, ash and carbohydrate by different of fresh meat, and fried meat including vacuum fried (VF) dendeng lambok and conventional fried (CF) dendeng lambok

3.2 Amino acids composition

The composition of the amino acids in the raw beef and *dendeng lambok* including vacuum fried *dendeng lambok* and conventional fried *dendeng lambok* is showed in Figure 2. The main amino acids in the raw beef were found to be L-Glutamic, L- Aspartat Acid and L-leusin whereas, the least amino acid was cysteine. In this study changes on almost all amino acids. From raw to fried beef, the vacuum frying seem not affect to the profile of amino acids while the conventional frying affected to the decreasing of amino acids. It has been reported that changes in the amino acid composition in food are mainly dependent on treatment [16]. Many references indicate that there is a significant deficiency in the amino acid composition during heating which can be attributed to protein denaturation

and the Millard reaction [17,18,19,20]. However our results show that there are chemical components in the absorbed *dendeng lambok* seasoning that can inhibit the process of destroying amino acids due to heat. It can be suggested that the lowering of the boiling point of the frying oil can lead to lesssdecomposition of the food which is extended by the nutrients of the seasoned food during heating [21].

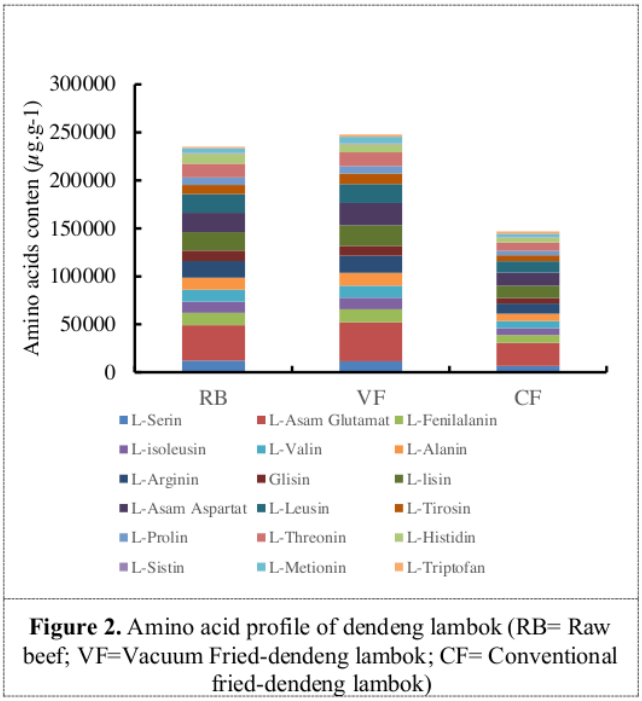

Figure 2. Amino acid profile of dendeng lambok (RB= Raw beef; VF=Vacuum Fried-dendeng lambok; CF= Conventional fried-dendeng lambok)

3.3 In-vitro protein digestibility

Protein digestibility is assumed as the proportion of protein that can be digested by enzymes so that it can be absorbed through the intestinal mucosa that can be absorbed in 100 g of food, or the percentage of protein digestibility multiplied by the concentration of protein in food [22]. Protein digestibility of the raw beef and fried beef including vacuum fried *dendeng lambok* and conventional fried *dendeng lambok* is represented in Figure 3.

The results showed that the process of fried-*dendeng lambok* in vacuum frying increased protein digestibility, while conventional frying reduced protein digestibility. This might cause by differences in temperature and pressure during the cooking process [22]. In vacuum frying the temperature used is low and conventional is higher. This is in accordance with Zhang, Xinhui, Wei & Jiaming [23] research, frying temperature can reduce protein digestibility in rabbit meat at 175°C fried for 6 minutes while processing at 95°C for 6 minutes can increase protein digestibility.

This high temperature during frying will activate chemical reactions in meat such as hydrolysis, conformational changes in protein structure, denaturation, Mailard reactions, cross-linking and other protein reactions. Some of these reactions can affect the increase in protein digestibility and some of them can reduce protein digestibility [24]. In particular, protein digestibility is altered because protein-lipid complexes are less susceptible to enzymatic proteolysis [25].

Another possible reason is that frying causes the formation of heterocyclic aromatic amines in protein-rich foods such as meat and fish at temperatures mostly over 150°C [26], which are considered difficult to decompose and dangerous because they are carcinogenic [27].

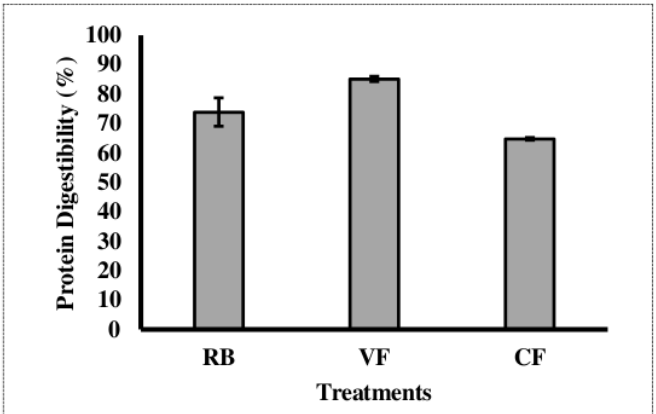

Figure 3. Protein Digestibility of dendeng lambok (RB= Raw beef; VF=Vacuum Fried-dendeng lambok; CF= Conventional fried-dendeng lambok)

3.4 Fatty acids composition

Fatty acid changes on treated *dendeng lambok* is presented in Table 1. Polyunsaturated fatty acids were dominated by oleic acid (C18 : 1 W9C) as the most abundant omega-9 fatty acid. The results showed that most of the fatty acids of raw beef significantly increas due to the frying process. Oil uptake could be the main reason of these increment of fatty acids [21]. The number of fatty acids in the treated product after vacuum frying process remain in the higher value compared to the conventional frying. The low temperature condition on vacuum frying process might inhibit the degradation of fatty acids. These results are similar to previous research which indicated that the use of vacuum conditions provides more advantages over conventional frying [21].

Table 1. Composition of fatty acids in treated *dendeng lambok*

Fatty acids (µg.g-1)	Fresh meat	Coventional frying	Vacuum Frying
Linolenic acid	0,0190	0,0201	0,0307
Linoleic Acid	0,0932	0,6170	1,4320
C 18:2 W6 (linoleic acid / w6)	0,0932	0,6170	1,4320
C 18: 1 W9C (c-oleic acid)	1,7575	4,6993	8,6291
C 17 : 1 (heptadecenoic acid)	not detected	0,0208	0,0309
C 16 : 1 (palmitoleic acid)	0,1375	0,2270	0,2158
C 20 : 4 w6 (arachidonic acid)	0,0227	0,0247	0,0468

C 15: 1 (pentadecenoic acid)	not detected	0,0076	0,0306
C 20 : 3 w6 (eicosatrienoic acid / w6)	not detected	0,0042	0,0086
Omega 6 fatty acids	0,1242	0,6540	1,4873
C 14 : 1 (miristoleic acid)	0,0375	0,0361	0,0345
C 13: 0 (tridecanoic acid)	0,1244	0,0454	0,0177
Omega 3 fatty acids	0,0136	0,0211	0,0307
C 18: 3 W3 (linolenic acid / w3)	not detected	0,0120	0,0307
Polyunsaturated fat	0,1378	0,6750	1,5179
C 18: 0 (stearic acid)	1,1292	1,1726	3,3712
C 17: 0 (heptadecanoic acid)	not detected	0,0317	0,0737
C 16: 0 (palmitic acid)	1,5030	2,9953	6,6845
Omega 9 fatty acids	1,7575	4,6993	8,6291
C 15: 0 (pentadecanoic acid)	0,0357	0,0289	0,0628
AA	not detected	0,0247	0,0468
C 14 : 0 (myristic acid)	0,3131	0,1582	0,3270
C 12: 0 (lauric acid)	0,0378	0,0198	0,0461
C 20: 1 (eicocyanic acid)	not detected	0,0109	0,0250
C 10: 0 (capric acid)	not detected	0,0028	0,0084
C 20: 0 (arachidic acid)	0,0104	0,0209	0,0601
Saturated fat	3,2334	4,4838	10,6513

4. Conclusion

Dendeng lambok is an Indonesian traditional meal that has the potential to be introduced to the rest of the iworld. The selection of suitable frying process in the preparation of dendeng lambok contribute not only to the taste and flavor of the dish, but also to its nutritional value. Dendeng lambok's nutritional properties have greatly enhanced as compared to raw beef. This research suggests that using of vacuum frying technique on the production of dendeng lambok could maintain characteristics of amino acids and fatty acids of raw beef while it had increased the In-vitro protein digetibility. Therefore,

the vacuum fried dendeng lambok has a bettter quality compare to the conventional fried dendeng lambok in the perpactive of amino acid, fatty acids and the protein digetibility.

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Data availability
The data used to support the findings of this study are available from the corresponding author upon request.

Conflict of interest
The authors declare that there is no conflict of interests regarding the publication of this paper.

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