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Effect of Rice Bran and Carboxymethyl Cellulose Addition on the Physicochemical Quality of Chicken Sausage Formulated with Red Palm mid Fraction

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Abstract: The objective of this study is to determine the effects of dietary fiber on the sensory properties of cooked chicken sausages by partial substitution of chicken fat (CF) with red palm mid fraction (RPMF). Four sausage formulations with the fat level of 5% were blended with rice bran 1.5% (RB) and carboxymethyl cellulose (CL). Instrumental analysis of water activity (a_w), cook loss, pH value and texture (hardness) were performed to measure physicochemical properties. Sensory properties were estimated using a hedonic test. Statistical analysis was performed by using SPSS. The results showed that this fiber is compatible when used with red palm mid fraction (RPMF) fat in chicken sausages. The panelists indicated that all the formulations except the treatment with RPMF+CL were not significantly different to the control in terms of acceptability. In conclusion, the lipid content, when substituting CF with RPMF, with rice bran carboxymethyl cellulose, yielded acceptable chicken nuggets. This indicates the RPMF and rice bran formulations were equally comparable or better than the CF formulation. It is recommended that multiple analyses with different analytical instrumentation (GC, FTIR and UV-Vis) may explain better the antioxidants behaviour and oxidative stability of the products.

Key words: Rice bran · Carboxymethyl cellulose · Red palm mid fraction · Physicochemical quality

INTRODUCTION

For many years, a fat-rich diet has been considered a major cause of atherosclerosis and cardiovascular disease. In order to lower the rates of heart diseases, cardiologists and nutritionists advise consumers to reduce the overall intake of saturated fatty acids which is thought to stimulate the production of low density lipoproteins (LDL, also known as bad cholesterol). Demands towards low fat meat products have prompted studies such as the production of low fat beef burgers [1]. Production of meat products are moving towards products with less fats, cholesterol, calories and salt to fulfill the demands of todays' health conscious consumers [2].

Moreover, in meat products, fat contributes towards the flavour, texture, mouthfeel and overall sensation of lubricity of the product. Previous report [3, 4], fat reduction can adversely affect the acceptability of a product and increase the toughness of meat products.

With the increased interest in reducing the ingestion of fat, low-fat products are being developed as they are perceived as more 'healthy' [5]. Multistage fractionation necessarily produces middle-melting fractions, usually called mid-fraction with iodine value 40-48. Palm mid fraction (PMF) concentrates the disaturated triglycerides and slip melting point temperature between 30- 38°C [6]. Palm mid fraction (PMF) has the most uses of palm oil in food and nonfood applications [7].

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Dietary fiber consists of non-digestible carbohydrates and lignin that are intrinsic and intact in plants [8]. Soluble dietary fibers, usually polysaccharides, were suggested to enhance the incidence of colorectal cancer [9]. Methylcellulose is water-soluble fiber which has been used in food for decades to enhance the manufacturing process and improve food product qualities [10]. Additionally, this food fiber is known to resist digestion in the human gastrointestinal tract [11] and have been shown to provide physiological benefits associated with dietary fibers [12]. As such, it meets physiological definition of dietary fiber, such as the definition proposed by the Association of American Cereal Chemists.

In addition to the physiological benefits provided by high fiber foods, studies have shown that fiber components can give texture, gelling, thickening, emulsifying and stabilizing properties to certain food [13, 14]. Studies have repeatedly shown that rice bran gives interesting health benefits. Compositional analysis reveals that rice bran consists of almost 27% dietary fibre and has been reported to have positive effects, such as laxative and cholesterol-lowering ability. Dietary fiber from defatted rice bran also has comparable water-binding capacity to FIBREX, a commercial fiber from sugar beet. This suggests that rice bran is a good fiber source that can be added to various food products [15].

Fiber addition in meat products is on the increase nowadays, due to its technological use and benefits to human health [16]. Mansor and Khalil [17] reported that the cholesterol content of uncooked and cooked beef burgers decreased with addition of wheat fiber. According to the National Cancer Institute [18] in US, increased proportion of fiber in foods are known to reduce the risk of cancer of the colon, obesity, cardiovascular disease and several other disorders. The objective of this study is to evaluate whether using added fibers improve the physical quality and sensory acceptability of plant fat substitution in processed meats.

MATERIALS AND METHODS

The formulation used in this study is based on the Smoked Tandoori Sausage recipe, which is commercialized by the brand name 'Omar Deli'. The sausage formulations were developed in OmCorp Sdn. Bhd., Kajang, Selangor. Four chicken sausage formulations were compared, each containing 5% fats. Two formulations (T1: CF+RB and T2: CF+CL) contained chicken skin as fat and the other two formulations (T3: RPMF+RB and T4: RPMF+CL) were incorporated with RPMF. T1 and T3 were added with 1.5% of rice bran while T2 and T4 were added with cellulose in same amount. Blends of RPMF were provided by the Carotino Sdn. Bhd. (Pasir Gudang, Johor). Defatted rice bran was supplied from Bernas Sri Tiram Jaya (Tanjung Karang, Selangor). Chicken breast trimmings, chicken skin and other dry materials were provided by OmCorp Sdn. Bhd.

Water Activity: Water activity (a_w) of sausages was determined by using the Aqua Lab Model Series 3 TE water activity at room temperature (24.9°C). Each ground sausage was weighted approximately 3 g and place in the plastic plate and which were inserted into the Aqua Lab instrument. The reading was displayed in digital number after 2-3 minutes.

Cook loss: Cooking loss was calculated as the difference of weight before and after cooking. Weight loss were determined after frying the sausages for 2 minutes at 175°C in a 'valentine batch' fryer until core temperature of the sausages reached 75 ºC. The cooking loss was calculated according to this formula:

$$\text{Cooking loss (\%)} = \frac{(\text{raw weight} - \text{cooked weight})}{\text{raw weight}} \times 100$$

Texture Analysis: Texture of the chicken sausages was performed using a texture analyzer (Shidmadzu Autograph AGS-J 500N). Hardness of the samples was obtained by applying an aluminum probe with a diameter of 2 mm to penetrate samples of 12 mm depth. The probe movement speed was 60mm/min.

pH Determination: 10 g of sausage sample for each treatment was grounded to small particle size. Then the samples were mixed with 100 ml distilled water and homogenized for 2 minutes. pH value was determined by Hanna Instrument pH 211 Microprocessor pH meter which had calibrated with buffer solution at pH 7.0 and 4.0. The pH value determination was done in triplicates.

Consumer (Hedonic Test): Hedonic test was carried out to determine preference or rejection of chicken sausage based on the sensory attributes. Sensory evaluation was carried out by 60 untrained consumers consisting of students and staffs of Islamic Science University of Malaysia (USIM). They evaluated samples for hedonic rating and attributes evaluated including colour, texture, taste, flavour, juiciness, overall acceptance and purchase

intent scale on a 7-points scale (1 = dislike extremely, 4 = neither like nor dislike and 7 = like extremely). Chilled sausage samples of each formulation were thawed for 20 minutes before steaming process prior to conducting sensory evaluation. The sausage samples were cut into 30 mm cylinders and kept warm in plastic containers until served. All sausages were served at room temperature. Distilled water was also provided. The higher rating indicated good quality attribute. Sausages were presented in three-digit coded glass containers and the order of serving was determined by random order.

Statistical Analysis: The data were subjected to a one way analysis of variance (ANOVA) and Duncan Multiple Range Test for significance using SPSS (Statistical Package for Social Science) version 12.0. The result significance was established at $p<0.05$ unless otherwise indicated.

RESULTS AND DISCUSSION

Water Activity (aw), Cook Loss and Texture: The result of water activity (a_w), percentages of cook loss and texture measurement in term of hardness are shown in Table 1. Water activity (a_w) of all samples do not show any significant differences ($p>0.05$) among all the treatments. Fresh meats have a water activity of 0.970-0.996 [19]. This result showed that the utilization of red palm mid fraction and chicken fat in sausage formulation does not influence the water activity of the products.

Compared to the cook loss percentages of sausage prepared with chicken fat in CF+RB and CF+CL samples, the utilization of red palm mid fraction (RPMF) reduced the cooking loss of sausages. Wilson *et al*. [20] stated that a meat product of good cooking quality should not lose more than 10% of its weight during cooking. For overall observation on the cook loss result, samples prepared with red palm mid fraction exhibited good cooking quality as cooking loss percentage in RPMF+RB sample is lower than the 10%, while RPMF+CL percentages value is not significantly different compared to RPMF+RB.

However, texture profile for hardness shows a significant difference between the samples especially for samples that were prepared with addition of cellulose which were CF+CL and RPMF+CL. The hardness is the force required to compress substance between the molar teeth (in the case of solid) or between the tongue and palate (in the case of semi-solids). The characteristics of fats are important in determining the textural properties of frankfurters as they form fat networks or agglomerates within the protein matrix of the frankfurters [21, 22]. Thus, the result indicate that texture in term of hardness of chicken sausage samples did not provide significant changes ($p<0.05$) between sample T1 (CF) and T4 (RPMF+RB).

pH Determination: The pH values of the chicken sausages for four different treatments were summarized in Table 2. The pH value of all sample ranged from 6.88 - 7.3.

Table 1: Water activities (aw), cook loss and texture for sausage samples during 9 days chilling storage

Treatments	Water activity (a_w)	Cook Loss (%)	Texture (hardness, N)
T1- CF+RB	0.972±0.0012^{a}	16.278±0.58^{a}	29.572±1.93^{ab}
T2- CF+CL	0.974±0.0007^{a}	13.373±0.21^{b}	37.985±2.58^{a}
T3- RPMF+RB	0.973±0.0026^{a}	9.327±0.76^{c}	25.833±1.87^{b}
T4- RPMF+CL	0.972±0.0007^{a}	10.298±0.93^{c}	32.376±4.92^{ab}

Mean of three samples for each treatment ± standard deviation (SDE) a-c: Different superscript letter indicate the significant different ($p> 0.05$) mean within the row.

Table 2: pH value for chicken sausage samples during 9 days chilled storage

	Treatment			
Day	T1 CF+RB	T2 CF+CL	T3 RPMF+RB	T4 RPMF+CL
1	7.03±0.008^{a}	6.99 ±0.120^{b}	6.89±0.008^{c}	6.91±0.018^{c}
3	7.02±0.013^{a}	6.98±0.012^{b}	6.88±0.008^{c}	6.91±0.017^{c}
5	7.01± 0.010^{a}	6.98±0.153^{a}	6.88±0.008^{b}	6.91±0.016^{b}
7	6.99±0.006^{a}	6.97±0.008^{a}	6.88±0.015^{c}	6.92±0.014^{b}
9	6.93±0.233^{ab}	6.97±0.008^{a}	6.88±0.240^{b}	6.92±0.012^{ab}

Mean of three samples for each treatment + standard deviation (SDE) a-c: Different superscript letter indicate the significant different ($p< 0.05$) between the column

Table 3: Consumer sensory evaluation (Hedonic) for chicken sausage samples

	Treatment			
Attributes	T1 CF+RB	T2 CF+CL	T3 RPMF+RB	T4 RPMF+CL
Firmness	4.92±0.499b	6.54±0.520a	6.08±0.514ab	6.08±0.251ab
Cohesiveness	4.92±0.468b	6.71±0.437a	6.25±0.372a	5.58±0.224ab
Meat flavour	6.17±0.458a	6.00±0.348a	5.58±0.543a	5.92±0.234a
Meat content	6.08±0.358a	5.83±0.474a	5.33±0.527a	5.65±0.212a
Juiciness	6.42±0.543a	6.00±0.590a	6.08±0.543a	6.25±0.252a
Oily Taste	4.83±0.575a	5.17±0.626a	5.75±0.411a	5.17±0.562a
Off-flavour	1.83±0.271b	4.67±0.555a	3.92±0.802a	4.75±0.494a
Overall palatability	7.08±0.358a	5.67±0.497ab	5.92±0.557ab	5.00±0.492b

Mean of three samples for each treatment + standard deviation (SDE) a-b: Different superscript letter indicate the significant different ($p< 0.05$) between the column

The differences among the pH values of the chicken sausages were significant ($p<0.05$) between the samples formulated with RPMF and CF. Thus, the utilization of RPMF cause the increased of pH value in sausage products.

Sensory Evaluation: Mean scores for various sensory attributes for the consumer (hedonic test) were shown in Table 3. Shiota *et al.* [23] found that sensory scores for aroma decreased with increasing level of palm oil and palm mid fraction in beef sausage. The relation of this information shown in this result of this study, indicated significant differences ($p<0.05$) in flavour or aroma between CF + RB, CF + CL samples for consumer sensory evaluation. Carpenter *et al*. [24] reported that the flavour of frankfurters is highly correlated with the overall acceptability and that flavour and overall acceptability are not highly correlated with the proportion of fat in the finished product.

In studying texture preference of sausages, panelists perceived no significant ($p>0.05$) difference between all treatments as shown in Table 3. Shiota *et al*. [23] observed that the impact of palmitic acid, abundant in palm olein and palm stearin, on the palatability of meat products could be detected in changes of mouth-feel or texture. The relationship between fatty acids components of adipose tissue, mechanical and textural variables of pure fats may also related with the palatability of the products.

Even though melting behaviors and solid fat contents of pure fats were altered by the changes in fatty acids composition, the mechanical and sensory textural variables of pure fats were only weakly affected. Thus, a slight different in melting behaviors among fats may exert insignificant effect towards consumer's texture perception. Total simulation of fatty acids composition might not be an essential criterion for vegetables oils to replace animal fats in meat products.

CONCLUSION

This study showed that substitution of animal fat with red palm fat and added fibers resulted in improved physical quality of the chicken sausage products, while maintaining the sensory quality of plant fat substitution in chicken sausages. The RPMF and rice bran formulations were equally comparable or better than the CF formulation. Based on the overall result, it can be suggest that the time for oxidation study need longer storage duration to see the good result plot and changes that occur can be determined clearly. No one method can accurately provide the oxidation results. It is recommended that multiple analyses with different analytical instrumentation (GC, FTIR and UV-Vis) may explain better the antioxidants behaviour and oxidative stability of the products.

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REFERENCES

1. Alina, A.R., A.S. Babji and S. Affandi, 2009. Nutritional quality of palm fat substituted chicken nuggets. Int. J. Food Sci. Nutr., 32(2): 181-188.
2. Alina, A.R., A.S. Babji and S. Affandi, 2009. Physical, texture and sensory properties of palm fats substituted chicken nuggets. J. Basic Appl. Sci., 1(1): 79-83.
3. Giese, J., 1996. Fat, oils and fat replacers. Food Technology, 50(4): 78-83.

4. Mendoza, E., M.L. Garcia, C. Casas and M.D. Selgas, 2001. Inulin as fat substitute in low fat, dry fermented sausages. Meat Sci., 57(4): 387-393.
5. Carrol, O.P., 1998. Trimming the fat. The World of Ingredient, 8(18): 11-14.
6. Timms, R.E., 1997. Lipid Technologies and Applications: Fractionation Lincoln, England, pp: 199-220.
7. Ahmed, M.A., M.A. Abdulmajid, M. Tarek and D. Abduljalil, 2012. E?ect of hydrogenation temperature on the palm mid-fraction fatty acids composition and conversion. J. King Saud Uni. Eng. Sci., 24(2012): 45-51.
8. Joanne, L.S., 2005. Dietary fiber and body weight. Nut., 3(21): 411-418.
9. Harris P.J. and L.R. Ferguson, 1999. Dietary fibers may protect or enhance carcinogenesis. Mutat Res., 443(1-2): 95-110.
10. Holownia, K.I., M.S. Chinnan, M.C. Erickson and P. Mallikarjunan, 2000. Quality evaluation of edible film-coated chicken strips and frying oils. J. Food Science, 65(2): 1087-1090.
11. Machle, W., F. Heyroth and S. Witherup, 1944. The fate of methylcellulose in the human digestive tract. J. Bio. Chem., 153(2): 551-559.
12. Dressman, J.B., C.H. Adair, J.L. Barnett, R.R. Berardi, V.A. Dunn-Kucharski and K.M. Jarvenpaa, 1993. High-molecularweight hydroxypropylmethylcellulose. A cholesterol-lowering agent. Arch. Intern. Med., 153(11): 1345-1353.
13. Dreher, M.L., 1987. Handbook of dietary fibre: an applied approach. New York: Marcel Dekker.
14. Sharma, S.C., 1981. Gums and hydrocolloids in oil-water emulsion. Food Tech., 35(1): 59-67.
15. Azizah, A.H. and Y.S. Luan, 1999. Functional properties of dietary fibre prepared from defatted rice bran. J. Food Chem., 68(14): 15-19.
16. Vendrell-Pascuas, S., A.I. Castellote-Bargallo and M.C. Lopez-Sabater, 2000. Determination of insulin in meat products by high-performance liquid chromatography with refractive index detection. J. Chromatogr., 881(2000): 591-597.
17. Mansor, E.H. and A.H. Khalil, 1997. Characteristic of low-fat beefburgers as influenced by various types of wheat fibers. Food Research Int., 30(3): 199-205.
18. National Cancer Institute, 1984. US Department of Health and Human Services, NIG Pub., 85: 2711.
19. Chirife, J. and C.F. Fontan, 1982. Some physico-chemical basis of food preservation by combined methods. J. Food Science, 47(5): 661-663.
20. Wilson, N.R.P., E.J. Dyett, R.B. Hughes and C.R.V. Jones, 1981. Meat and meat products: Factor affecting quality control. London: Elsevier.
21. Lee, C.M., J.W. Hampson and A. Abdollahi, 1981. Effect of plastic fats on thermal stability and mechanical properties of fat-protein gel products. J. Am. Oil Chem. Soc., 58(3): 983-987.
22. Tan, S.S., 2002. Optimizing the palm oil and palm stearin utilization in chicken frankfurter formulation. PhD thesis. Universiti Kebangsaan Malaysia, Department of Food Science, pp: 64.
23. Shiota K., S. Kawahara, A. Tajima, T.K. Ogata and T. Ito, 1995. Sensory evaluation of beef patties and sausages containing lipids with various component fatty acids. Meat Science, 40(10): 363-371.
24. Carpenter, J. A., R.L. Saffle and S.A. Christian, 1996. The effects of type of meat and level of fat on organoleotic and other qualities of frankfurters. Food Tech., 20(3): 693.