ARTICLE

Effect of Maltodextrin as Fat Replacer on Proximate Composition and Sensory Characteristics of Low Fat Chicken Burger Patty

Chua Tao Phiaw and Nurul'azah Mohd. Yaakub *

Faculty of Sustainable Agriculture, Universiti Malaysia Sabah, Locked Bag No. 3, 90509 Sandakan, Sabah, Malaysia

E-mail: nurulazah@ums.edu.my

With the rise of recent concerns on health issues, it is clear that consumers are being more cautious on fat content in food. Meat industry came up with advance technological methods to modify the meat products to suit the healthier recommendations. The production of low fat chicken burger patty using broiler meat was conducted using maltodextrin (0.25-0.75%) as fat replacer with constant of 1% salt, 0.5% onion, 0.25% mixed spices and using two different levels (90% and 92.5%) of chicken meat. This study showed that 0.25, 0.50 and 0.75% of maltodextrin used had given significant (p<0.05) effects on sensory but slightly on proximate composition. There were significant difference (p<0.05) on ash, crude fat and crude protein analysis but no significant differences (p>0.05) were seen in moisture analysis. The lowest fat of patty formulation was F4 (90% chicken meat and 0.25% maltodextrin). For sensory analysis, F5 (90% chicken meat and 0.5% maltodextrin) showed most sensory acceptance compared to other formulations. In conclusion, F4 (90% chicken meat with 0.25% maltodextrin) gave the lowest fat percentage with acceptable sensory characteristics in low fat chicken patty production.

.

Introduction

According to Lo et al., (2008), the incident of obesity is on the rise in recent years mainly due to human diet. Cardiovascular disease, often caused by high consumption of oily, fatty and sodium food is one of the major causes of death. Hence, to improve the health of the human population, various recommendations for better nutritional plan has been introduced by nutritional organizations such as World Health Organization (Simopoulos et al., 1999; WHO, 2003). Such plans include daily intake of fats should be in a range of 15% to 30% of the total diet and calorie intake of no more than 10% is to be from saturated fatty acid.

Therefore, these recommendations have resulted in consumers to be aware and reduce intake of food with high saturated fatty acids such as red meat. However, Norton and Sun (2008) claims that some consumers would not change their dietary plans, resulting to food formulation to suit the recommended dietary changes. Givens et al., (2000), and Scollan et al., (2000) reported that the most commonly used method to lower fats in food products is via the animal's nutrition with implementations of forages and dietary lipids.

Hence, instead of manipulating the animal's nutrition, meat industry came up with advance ingredient formulation to modify the meat products to suit the healthier recommendations. The potential ingredients used for formulations should be safe and causes no hazardous health effects. The product of this research is expected to contribute as a healthier commercial choice for fast food product. Previously, Troy et al., (1999) carried out a research on replacing fats in low fat beef burger by using tapioca starch, carrageenan, oat fiber, pectin, and whey protein. The results of the study showed that fat replacers have the ability to enhance cooking characteristics as well as retain high capacity of water in burger patties.

Maltodextrins are non-sweet, nutritive mixtures of saccharide polymers and produced by partial hydrolysis of starch obtained from corn or potato starch. It is also used to build solids and viscosity, bind/control water, and contribute smooth mouth feel in fat replacing systems such as cream imitation, processed meat and frozen desserts (Akoh, 1998). Previously Ibrahim (2011) also reported that maltodextrin had the highest sensory evaluation compared to other fat replacers. This current study will evaluate and relate the best level of maltodextrin for both sensory and nutritional composition.

Materials and Methods

Burger patty formulation

Six formulations of low fat burger patties were required in patty production using easily available materials such as fat replacer, chicken, salt, onion, garlic, mixed spices and iced water. Formulations of the low fat burger patties were based on two factors made using two levels of

chicken meat (92.5% and 90%) and three levels of maltodextrin (0.25%, 0.50% and 0.75%) as shown in Table 1.

Table 1. Formulations of chicken low fat burger patties.

1	Content (%)						Maltodextrin
	Salt	Onion	Garlic	Mixed Spices	Iced Water	Chicken meat	
1	1.0	0.5	0.25	0.25	5.25	92.5	0.25
2					5.0		0.50
3					4.75		0.75
4					7.75		0.25
5					7.5	90.0	0.50
6					7.25		0.75

Burger patty proximate composition

The proximate composition of uncooked burgers was analyzed according to AOAC International method (AOAC International, 2000). Moisture content was determined using the air oven drying method. Ash content was determined using the dry ashing method. Protein content was determined using the Kjeldahl method using 6.25 as nitrogen factor, and fat content was analysed by the Soxhlet method and carbohydrate content was calculated using the differential weights of all compounds as referred to Merrill and Watt (1973).

Sensory evaluation

The round - shape with 50g weight prepared burger pieces were cooked on hot plate set at 170 -190°C. Every piece was cut into four parts and provided to the sensory panelists. Sensory evaluation was performed by 30 semi-trained panel members 20 - 24 year old from undergraduate students of the Faculty of Sustainable Agriculture, UMS, Malaysia. The students were asked to indicate how much they liked or disliked the processed burgers using hedonic scale (1= dislike extremely, 7 = like extremely) according to the attributes of color, aroma, tenderness, juiciness, flavor, chewiness and overall acceptability. Scores were obtained and statistically analyzed. The formulations was randomized with balanced incomplete block design (BIB) formulation followed the Cochran and Cox (1957) method. Each panelist was given 3 different coded burger formulations with each formulations being replicated for 15 times.

Statistical analysis

All the data of analysis were analyzed using analysis of variance (ANOVA) and Duncan's multiple range test to determine the significance between the mean (p<0.05) using a programmed SPSS 22.

Results and Discussion

Proximate composition

Table 1 recorded the result of proximate analysis done on the six different patty formulations. From the data analyzed, the different patty formulations showed significant difference (p<0.05) for ash content, crude fat and crude protein but no significant difference (p>0.05) for moisture.

Table 2. Proximate composition of different patty formulations

Proximate Composition (%)	Patty Formulation					
	1	2	3	4	5	6
Moisture	61.88^{a} ± 0.34	63.27^{a} ± 0.62	63.82^{a} ± 0.96	63.17^{a} ± 0.62	60.77^{a} ± 2.94	64.41^{a} ± 2.34
Ash	5.17^{ab} ± 0.64	5.67^{ab} ± 0.98	5.64^{ab} ± 0.27	4.58^{a} ± 0.80	6.86^{bc} ± 0.83	8.46^{c} ± 1.17
Crude Fat	10.43^{b} ± 1.32	8.35^{ab} ± 0.53	7.93^{ab} ± 0.84	7.75^{a} ± 0.06	10.03^{ab} ± 1.38	8.92^{ab} ± 0.84
Crude Protein	15.89^{a} ± 0.14	15.75^{a} ± 0.20	15.51^{a} ± 0.29	13.37^{b} ± 1.47	13.75^{b} ± 0.24	13.43^{b} ± 0.78

Data are means of triplicates ± SEM. Different letters in the same column indicate significant difference at p< 0.05.

From Table 2, there was no significant difference for moisture content between different patty formulations. The highest moisture content was shown by formulation number six with 64.41% whereas the lowest moisture content was shown by formulation number five with 60.77%. This result conforms to those presented by Jimenez-Colmenero (1996), where moisture level increases in reduced fat meat products due to high meat content and high level of soluble solids. Moreover, the high moisture content found in both three and six patty formulation indicated that the addition of maltodextrin improved the water holding capacity which conforms to what was being reported by Huffman and Egbert (2000).

For ash content, Table 2 showed that there was significant difference between the patty formulation where formulation one and four differed from that of formulation two, three, five and six. This study is in accordance with Fernández-López et al., (2006) stated that high ash content was related to the sum of total minerals presented in food which could be contributed by the meat, salt, spices and other ingredient added.

As for crude fat content, Table 2 indicated there was significant difference between the patty formulations. According to Jimenez-Colmenero (1996), low fat food products can be achieved by having higher moisture content level. This agrees with the current study. Nevertheless, all patty formulation except for formulation number one can be classified as low fat meat products as it complied with Dreeling et al., (2000), Suman and Sharma (2003), Troy et al., (1999) and Turhan et al., (2009) suggesting that low fat burgers usually consists of fat contents at 10% or below. This study also shows that there was an interaction between meat percentage and maltodextrin (p<0.05) which suggested that both meat percentage used and percentage of maltodextrin used had contribute to the crude fat content.

For crude protein content, Table 2 displayed that there was significant difference between the patty formulations.

Formulation one had the highest crude protein content and formulation four with the least crude protein content. This result agrees with Caceres et al., (2006) stating that the higher the amount of raw material present in the formulation, the higher the protein content which in this case formulation one, two and three had more chicken meat in their formulation. This study also agrees with Ramadhan et al., (2011) reported stating that most Malaysian commercial chicken burgers had crude protein content of 11.08% - 18.77%.

Sensory acceptance

Table 3 recorded the sensory results from six different attributes used in sensory analysis of six different patty formulations. From the data analyzed, sensory attribute for aroma, tenderness and juiciness showed no significant difference (p>0.05) from different patty formulations whereas color and overall acceptability attribute showed significant difference (p<0.05) from the different patty formulations.

Table 3. Sensory attribute of different patty formulations

Sensory Attribute	Formulation					
	1	2	3	4	5	6
Color	4.53^{a} ± 1.30	5.27^{ab} ± 1.16	5.67^{b} ± 0.90	5.80^{b} ± 1.15	5.93^{b} ± 0.70	5.80^{b} ± 0.862
Aroma	5.73^{a} ± 0.80	5.47^{a} ± 0.99	6.00^{a} ± 0.76	5.93^{a} ± 1.34	5.73^{a} ± 0.88	6.00^{a} ± 1.20
Tenderness	5.47^{a} ± 1.19	4.93^{a} ± 1.34	4.80^{a} ± 1.08	6.00^{a} ± 0.76	5.13^{a} ± 1.60	5.33^{a} ± 1.05
Juiciness	5.60^{a} ± 0.99	4.67^{a} ± 1.11	4.73^{a} ± 1.28	5.80^{a} ± 1.21	5.53^{a} ± 1.19	5.40^{a} ± 0.91
Flavor	4.40^{ab} ± 1.30	4.00^{a} ± 1.46	4.87^{abc} ± 1.25	5.60^{bc} ± 1.18	5.87^{c} ± 1.25	5.53^{bc} ± 1.41
Overall Acceptability	5.27^{ab} ± 1.03	4.33^{a} ± 1.29	5.13^{ab} ± 1.25	6.00^{c} ± 0.93	6.13^{c} ± 1.06	5.80^{c} ± 1.15

Data are means of triplicates ± SEM. Different letters in the same column indicate significant difference at p< 0.05

The Table 3 has showed there are significant differences for the color attribute for different patty formulations. The highest value for color attribute was formulation five followed by formulation number four and six. Ibrahim et al., (2011) reported that patty formulation with maltodextrin had significant higher color attribute values. In this study, with higher level of maltodextrin used in were present in formulation number three and six with six having the highest value among formulation four, five and six where these three formulations had the same amount of meat and formulation number three being the highest among formulation one, two and three which were of the same group. Sayago-Ayerdi et al., (2009) reported that color attribute was the major factor judge by a consumer's preferences. This also depends on the concentration and chemical state of meat pigment, physical properties of meat and presence of non-meat ingredients. Ramadhan et al., (2012) also reported that color properties were affected by spices used in patty formulations as well as the griddling practice for cooking which included time of cooking contributed to color of the patties.

For aroma attribute, Table 3 showed there was no significant difference (p<0.05) between the patty formulations. According to Shahidi (2002), it was stated that the desirable flavor compounds and aromas in cooked meat products were the result of the thermal oxidative changes of lipids. Hence, with higher level of lipids present indicated better aroma. In this case, it contradicts with current study where the highest crude fat content was present in formulation one. Ali and Rasool (2007) reported that sensory attribute of color correlated with changes in aroma and flavor. Hence, the variation in aroma may had affected by the spices used and cooking practice as well (Ramadhan et al., 2012).

As for the attribute tenderness, Table 3 did not show any significant difference between the different formulations. The highest value of tenderness was formulation number four, followed by formulation one and six. The lowest value of tenderness was formulation number three. This study agrees with that tenderness increased improved in patties containing fat replacer due to hydration properties (Berry and Wergin, 1993).

No significant difference on juiciness shown form Table 3, and the result it indicated the highest juiciness value was patty formulation number four with 5.80 and the lowest was formulation number two with 4.67. This again contradicts with the findings of Troy et al., (1999) stating high fat content meat products had high tenderness and juiciness. However, this study also concurs with Claus, Hunt and Kastner, (1990) reported that juiciness scores increased as a huge factor due to increased added water. Hence, it was suggested that higher water holding capacity properties of fat replacer caused higher juiciness scores. This study also suggested that different percentage of meat in formulation had distinct effect on the juiciness whereby higher percentage of meat indicated lower juiciness scored when compared with lower percentage of meat even though both had similar percentage of maltodextrin.

For flavor attribute, there was significant difference between the patty formulations showed from Table 3. The result showed that formulation number five had the highest flavor value of 5.87 whereas formulation number two has the lowest flavor value of 4.00. Fat contributes to flavor (Moghazy, 1999), thus, the results from the analyzed data showed that formulation five had the highest flavor value followed by formulation number four then six. Since, formulation four, five and six were all containing lower meat content, hence, the flavor of these three formulations should not be the highest. However, the crude fat content from this study contradicts that of the flavor attribute. Hence, this might had happened due to consumers' preferences.

From Table 3, the attribute for overall acceptability showed there was significant differences (p<0.05). The highest formulation with overall acceptability was the

formulation number five followed by formulation number four, while the lowest value of overall acceptability was formulation number two. Crehan et al., (2000) claimed that panelists detected a decrease in overall acceptability when fat level was reduced with the addition of maltodextrin. However, this contradicts with this study where formulation four with least fat content had the second highest overall acceptability. It was suggested that this might occur due to consumer's preferences.

Conclusions

From the present research, it is apparent that lowest chicken meat in the burger patty formulation contributes to lowest fat content. F5 showed better sensory acceptance in the attributes of color, flavor and overall acceptability compared to other formulations. In other words, chicken patty with less meat and addition of maltodextrin has less fat gives better sensory preferences. As an overall, F4 satisfied both the proximate composition and sensory acceptance where F4 showed the lowest fat content and had better sensory results. Maltodextrin corporation in low fat burger patty ingredient gives significant effect on sensory acceptance on lower chicken meat formulation.

Acknowledgement

This study is partially supported by Faculty of Sustainable Agriculture, Universiti Malaysia Sabah.

Conflict of Interest

All the authors declare that they have no conflict of interest.

References

1 A. L. Merrill and B. K. Watt. (1973). Carbohydrate. In: Energy Value of Foods – Basis and Derivation. USA: USDA. 1973, pp, 2-3.
2 Akoh, C. C. (1998). Fat Replacers. Journal of Food Technology. 52, 47 – 53.
3 Ali, S. W. and Rasool, G. (2007). Chemical and Sensory Characteristics of Frozen Stored Chicken Patties Fried in Different Vegetable Oils. Pakistan Journal of Agriculture, 44(2), 337-340.
4 Association of Official Analytical Chemists. Official Methods of Analysis of the Association of Official Analytical ChemistsM.18th ed. AOAC Press, Gaithersburg. 2006.
5 Berry, B. W. and Wergin, W. P. (1993). Modified Pre-gelatinized Potato Starch in Low-Fat Ground Beef Patties. Journal of Muscle Foods, 4, 305-320.
6 Caceres, E., Garcia, M. L., and Selgas M. D. (2006). Design of a New Cooked Meat Sausage Enriched with Calcium. Meat Science, 73, 368-377.
7 Claus, J. R., Hunt, M. C. and Kastner, C. L. (1990). Effect of Substituting added Water for Fat on the Textural, Sensory and Processing Characteristics on Bologna. Journal of Muscle Foods, 1, 1-21.
8 Cochran, W. G. and Cox, G. M. (1957). Experimental Designs. New York: John Wiley and Sons Incorporated.
9 Crehan, C. M., Hughes, E., Troy, D. J. and Buckley, D. J. (2000). Effects of Fat Level and Maltodextrin on the Functional Properties of Frankfurters Formulated with 5, 12 and 30% fat. Meat Science, 55(4), 463-469.
10 Dreeling, N., Allen, P. and Butler, F. (2000). Effect of Cooking Method on Sensory and Instrumental Texture Attributes of Low-Fat Beef Burgers. Lebensmittel-Wissenschaftund-Technologie, 33(3), 234-238.
11 Fernández-López, J., Jiménez, S., Sayas-Barberá, E., Sendra, E. and Pérez-Alvarez, J. A. (2006). Quality Characteristics of Ostrich (Struthio camelus) Burgers. Meat Science, 73(2), 295-303.
12 Givens, D. I., Cottril, B. R., Davies, M., Lee, P., Mandbridge, R. and Moss, A. R. (2000). Sources of n-3 Polyunsaturated Fatty Acids Additional to Fish Oil for Livestock Diets. Nutrition Abstracts and Reviews, 70(1), 1-19.
13 Huffman, D.L. and Egbert, W.R. (1990). Advances in Lean Ground Beef Production. Alabama Agricultural Exp. Sta. Bull., no. 606, Auburn University, Alabama.
14 Ibrahim, M. A., Salama, M. F., and Hussein, A. A. 2011. Production of Functional Low- Fat Chicken Burger. Australian Journal of Basic Applied Sciences 5(12), 3149-3154.
15 Jimenez-Colmenero, F. (1996). Technologies for developing Low-Fat Meat Products. Trends in Food Science and Technology, 7, 41-48.
16 Lo, S. K., Tan, C. P, Long, K., Affandi Yusoff, M. S. and Lai, O. M. (2008). Diacylglycerl Oil Properties, Processes and Products: A review. Journal of Food and Bioprocess Technology, 1, 223-233.
17 Moghazy, E. A. (1999). Reduced-Fat Sausage as Affected by Using Fat Replacers, Natural Beef Flavour and Collagen Casings. Egypt Journal of Agricultural Research, pp, 77-2.
18 Norton, T. and Sun D. W. (2008). Recent Advances in the Use of High Pressure as an Effective Processing Technique in the Food Industry. Food and Bioprocess Technology, 1, 2-34.
19 Ramadhan, K., Huda, N. and Ahmad, R. (2011). Physiochemical Characteristics and Sensory Properties of Selected Malaysian Commercial Chicken Burgers. International Food Research Journal, 18(4), 1349-1357.
20 Sáyago-Ayerdi, S. G., Brenes, A. and Goñi, I. (2009). Effect of Grape Antioxidant Dietary Fiber on the Lipid Oxidation of Raw and Cooked Chicken Hamburgers. LWT – Food Science and Technology 42, 971-976.
21 Scollan, N., Hocquette, J. F., Nuernberg, K., Dannenberger, D., Richradson, I and Moloney, A. (2006). Innovations in Beef Production Systems that Enhances the Nutritional and Health Value of Beef Lipids and their Relationship with Meat Quality. Meat Science, 74, 17-33.
22 Shahidi, F. (2002). Lipid Derived Flavours in Meat Products. In Kerry, E. J., Kerry, J., and Ledward, D. (Eds.). Meat Processing: Improving Quality. Woodhead Publishing Ltd, Cambridge. Pp, 105-121.
23 Simopoulos, A. P., Leaf, A., and Salem, N. (1999). Workshop on the essentiality and recommended dietary intakes for omega-6 and omega-3 fatty acids. Journal of the American College of Nutrition, 18(5), 487–489.
24 Suman, S. P. and Sharma, B. D. (2003). Effect of Grind Size and Fat Levels on the Physicochemical and Sensory Characteristics of Low-Fat Ground Buffalo Meat Patties. Meat Science, 65(3), 973-976.
25 Troy, D. J., Desmond, E. M., and Buckley, D. J. (1999). Eating Quality of Low-Fat Beef Burgers containing Fat-Replacing Functional Blends. Journal of Science Agriculture, 79, 509.
26 Turhan, S., Temiz, H. and Sagir, I. (2009). Characteristic of Beef Patties using Okara Powder. Journal of Muscle Foods, 20(1), 89-100.
World Health Organization. (2003). Diet, Nutrition and the Prevention of Chronic Diseases. WHO Technical Report Series 916. Geneva, Switzerland.