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EFFECT OF FAT REPLACEMENT WITH DIFFERENT TYPES OF EGGPLANTS ON THE PHYSICOCHEMICAL AND SENSORIAL PROPERTIES OF CHICKEN SAUSAGES: A CHEMOMETRIC APPROACH [Kesan Penggantian Lemak dengan Pelbagai Jenis Terung terhadap Sifat Fisikokimia dan Deria Rasa Sosej Ayam: Pendekatan secara Kemometrik]

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Abstract

Animal fat plays an important role in processed meat products as it is responsible for improving some physicochemical and sensorial qualities of the final products. However, consumption of high-fat food products is linked to a higher risk of various cardiometabolic diseases such as type 2 diabetes mellitus and cardiovascular diseases. Eggplant has the potential to be used as a fat replacer, but different types of eggplants could produce various results. Thus, this study aimed to produce reduced-fat chicken sausages re-formulated with five different types of eggplants [Round Asian Eggplant (RAE), Pearl Red Eggplant (PRE), Pea Eggplant (PE), Round Black Eggplant (RBE), and Green Thai Eggplant (GTE)] as the fat replacers. The chicken sausages were evaluated for physicochemical and sensorial properties and compared to sausage containing only chicken fat as the control. The RAE, PRE, and PE sausages had the lowest fat content at 4.34%, 6.30% and 7.64%, respectively, thus can be claimed as reduced fat chicken sausages. There were no significant differences among all formulations in terms of ash, moisture, protein, cooking loss, water holding capacity, springiness, and cohesiveness. The sensory analysis revealed that consumers accepted the RAE and PRE sausages compared to the control and the least preferred was PE. This was supported by the PCA, which positively proposed lower fat content (4.34%) and higher a* value (3.21) while rejecting higher pH (6.35) and b* values (15.88) of the reduced-fat-chicken sausages. In conclusion, eggplants can be used as fat replacers to produce reduced-fat chicken sausages with Round Asian Eggplant being the best option. © 2022, Malaysian Society of Analytical Sciences. All rights reserved.

Author Keywords

chicken meat products; fat mimetics; fat replacers; healthier meat products; low-fat sausages

References

- Asyrul-Izhar, A. B., Bakar, J., Sazili, A. Q., Meng, G. Y., Ismail-Fitry, M. R.
Incorporation of different physical forms of fat replacers in the production of low-fat/ reduced-fat meat products; which is more practical?
(2022) *Food Reviews International*, 2022, pp. 1-33.
- Grasso, S., Brunton, N. P., Lyng, J. G., Lalor, F., Monahan, F. J.
Healthy processed meat products-Regulatory, reformulation and consumer challenges
(2014) *Trends in Food Science & Technology*, 39 (1), pp. 4-17.
- Felisberto, M. H. F., Galvão, M. T. E. L., Picone, C. S. F., Cunha, R. L., Pollonio, M. A. R.
Effect of prebiotic ingredients on the rheological properties and microstructure of reduced-sodium and low-fat meat emulsions
(2015) *LWT-Food Science and Technology*, 60 (1), pp. 148-155.
- Cengiz, E., Gokoglu, N.
Changes in energy and cholesterol contents of frankfurter-type sausages with fat reduction and fat replacer addition
(2005) *Food Chemistry*, 91 (3), pp. 443-447.

- Choi, Y. S., Choi, J. H., Han, D. J., Kim, H. Y., Lee, M. A., Kim, H. W., Jeong, J. Y., Kim, C. J.
Characteristics of low-fat meat emulsion systems with pork fat replaced by vegetable oils and rice bran fiber
(2009) *Meat Science*, 82 (2), pp. 266-271.
- (2014) *International Law Book Services*, pp. 89-90.
Petaling Jaya
- Niño-Medina, G., Urías-Orona, V., Muy-Rangel, M. D., Heredia, J. B.
Structure and content of phenolics in eggplant (*Solanum melongena*)-a review
(2017) *South African Journal of Botany*, 111, pp. 161-169.
- Weese, T. L., Bohs, L.
Eggplant origins: out of Africa, into the Orient
(2010) *Taxon*, 59 (1), pp. 49-56.
- Maroto, J. V.
Parte Sexta: Hortalizas aprovechables por sus frutos
(2002) *Horticultura Herbácea Especial*, pp. 481-495.
5ta. ed. Ediciones Mundi-Prensa, México DF, México
- Pua, E.C., Davey, M.R.
(2007) *Biotechnology in agriculture and forestry, transgenic crops IV*, pp. 201-219.
(Eds). Springer Verlag, Berlin, Heidelberg, Berlin
- Ammar, M. S.
Producing of high fiber chicken meat nuggets by using different fiber sources
(2017) *Middle East Journal of Agriculture Research*, 6 (2), pp. 415-423.
- Fraikue, F. B.
Unveiling the potential utility of eggplant: a review
(2016) *Conference Proceedings of INCEDI*, pp. 883-895.
- Akesowan, A., Jariyawaranugoon, U.
Optimization of salt reduction and eggplant powder for chicken nugget formulation with white button mushroom as a meat extender
(2021) *Food Research*, 5 (1), pp. 277-284.
- Sembring, H. S. B., Chin, K. B.
Antioxidant activities of eggplant (*Solanum melongena*) powder with different drying methods and addition levels to pork sausages
(2021) *Food Science of Animal Resources*, 41 (4), pp. 715-730.
- Zhu, Y., Zhang, Y., Peng, Z.
Effect of eggplant powder on the physicochemical and sensory characteristics of reduced-fat pork sausages
(2021) *Foods*, 10 (4), p. 743.
- (2005) *Official method of analysis of the AOAC*,
Association of Officiating Analytical Chemists (AOAC) 18th ed. United States
- Ismail, N. A., Bakar, J., Sazili, A. Q., Ismail-Fitry, M. R.
Effect of different levels of fat, sodium chloride, and sodium tripolyphosphate on the physicochemical and microstructure properties of Jamnapari goat meat emulsion modelling system
(2021) *International Food Research Journal*, 28 (5), pp. 916-925.
- Ramle, N. A., Zulkunain, M., Ismail-Fitry, M. R.
Replacing animal fat with edible mushrooms: a strategy to produce high-quality and

- low-fat buffalo meatballs**
(2021) *International Food Research Journal*, 28 (5), pp. 905-915.
- Sharin, S. N., Sani, M. S. A., Jaafar, M. A., Yuswan, M. H., Kassim, N. K., Manaf, Y. N., Wasoh, H., Hashim, A. M.
Discrimination of Malaysian stingless bee honey from different entomological origins based on physicochemical properties and volatile compound profiles using chemometrics and machine learning
(2021) *Food Chemistry*, 346, p. 128654.
 - Ismail, A. M., Sani, M. S. A., Azid, A., Zaki, N. N. M., Arshad, S., Tukiran, N. A., Abidin, S. A. S. Z., Ismail, A.
Food forensics on gelatine source via ultra-high-performance liquid chromatography diode-array detector and principal component analysis
(2021) *SN Applied Sciences*, 3 (79), pp. 1-19.
 - Uthumporn, U., Fazilah, A., Tajul, A. Y., Maizura, M., Ruri, A. S.
Physico-chemical and antioxidant properties of eggplant flour as a functional ingredient
(2016) *Advance Journal of Food Science and Technology*, 12 (5), pp. 235-243.
 - dos Santos, B. A., Campagnol, P. C. B., Pacheco, M. T. B., Pollonio, M. A. R.
Fructooligosaccharides as a fat replacer in fermented cooked sausages
(2012) *International Journal of Food Science & Technology*, 47 (6), pp. 1183-1192.
 - Cengiz, E., Gokoglu, N.
Effects of fat reduction and fat replacer addition on some quality characteristics of frankfurter-type sausages
(2007) *International Journal of Food Science & Technology*, 42 (3), pp. 366-372.
 - San José, R., Sánchez, M. C., Cámara, M. M., Prohens, J.
Composition of eggplant cultivars of the Occidental type and implications for the improvement of nutritional and functional quality
(2013) *International Journal of Food Science & Technology*, 48 (12), pp. 2490-2499.
 - Bunmee, T., Setthaya, P., Chaiwang, N., Sansawat, T.
Effect of purple eggplant flour on physicochemical, lipid oxidation, and sensory properties of low-fat beef patties
(2022) *International Journal of Food Science*, 2022, p. 9753201.
 - Fan, R., Zhou, D., Cao, X.
Evaluation of oat β -glucan-marine collagen peptide mixed gel and its application as the fat replacer in the sausage products
(2020) *Plos One*, 15 (5), p. e0233447.
 - Huda, N., Wei, L. H., Jean, A. T., Ismail, I.
Physicochemical properties of Malaysian commercial chicken sausages
(2010) *International Journal of Poultry Science*, 9 (10), pp. 954-958.
 - Kahar, S. N. S., Ismail-Fitry, M. R., Yusoff, M. M., Rozzamri, A., Bakar, J., Ibadullah, W. Z. W.
Substitution of fat with various types of squashes and gourds from the Cucurbitaceae family in the production of low-fat buffalo meat patties
(2021) *Malaysian Applied Biology*, 50 (1), pp. 169-179.
 - Feng, T., Ye, R., Zhuang, H., Rong, Z., Fang, Z., Wang, Y., Gu, Z., Jin, Z.
Physicochemical properties and sensory evaluation of Mesona Blumes gum/rice starch mixed gels as fat-substitutes in Chinese Cantonese-style sausage
(2013) *Food Research International*, 50 (1), pp. 85-93.

- Figuerola, F., Hurtado, M. L., Estévez, A. M., Chiffelle, I., Asenjo, F.
Fibre concentrates from apple pomace and citrus peel as potential fibre sources for food enrichment
(2005) *Food chemistry*, 91 (3), pp. 395-401.
- Lee, C. H., Chin, K. B.
Evaluation of physicochemical and textural properties of myofibrillar protein gels and low-fat model sausage containing various levels of curdlan
(2019) *Asian-Australasian Journal of Animal Sciences*, 32 (1), p. 144.
- Morin, L. A., Temelli, F., McMullen, L.
Interactions between meat proteins and barley (*Hordeum spp.*) β -glucan within a reduced-fat breakfast sausage system
(2004) *Meat Science*, 68 (3), pp. 419-430.
- Cao, L., Rasco, B. A., Tang, J., Niu, L., Lai, K., Fan, Y., Huang, Y.
Effects of freshness on the cook loss and shrinkage of grass carp (*Ctenopharyngodon idellus*) fillets following pasteurization
(2016) *International Journal of Food Properties*, 19 (10), pp. 2297-2306.
- Moghtadaei, M., Soltanizadeh, N., Goli, S. A. H.
Production of sesame oil oleogels based on beeswax and application as partial substitutes of animal fat in beef burger
(2018) *Food Research International*, 108, pp. 368-377.
- Choe, J. H., Kim, H. Y., Lee, J. M., Kim, Y. J., Kim, C. J.
Quality of frankfurter-type sausages with added pig skin and wheat fiber mixture as fat replacers
(2013) *Meat Science*, 93 (4), pp. 849-854.
- Zayas, J. F.
Structural and water binding properties of meat emulsions prepared with emulsified and unemulsified fat
(1985) *Journal of Food Science*, 50 (3), pp. 689-692.
- Das, A. K., Anjaneyulu, A. S. R., Gadekar, Y. P., Singh, R. P., Pragati, H.
Effect of full-fat soy paste and textured soy granules on quality and shelf-life of goat meat nuggets in frozen storage
(2008) *Meat Science*, 80 (3), pp. 607-614.
- Lee, C. H., Chin, K. B.
Effects of pork gelatin levels on the physicochemical and textural properties of model sausages at different fat levels
(2016) *LWT-Food Science and Technology*, 74, pp. 325-330.
- Troy, D. J., Kerry, J. P.
Consumer perception and the role of science in the meat industry
(2010) *Meat Science*, 86 (1), pp. 214-226.
- Kang, Z. L., Wang, T. T., Li, Y. P., Li, K., Ma, H. J.
Effect of sodium alginate on physical-chemical, protein conformation and sensory of low-fat frankfurters
(2020) *Meat Science*, 162, p. 108043.
- Park, K. S., Choi, Y. S., Kim, H. Y., Kim, H. W., Song, D. H., Hwang, K. E., Choi, S. G., Kim, C. J.
Quality characteristics of chicken emulsion sausages with different levels of Makgeolli lees fiber
(2012) *Food Science of Animal Resources*, 32 (1), pp. 54-61.

- Ferjančič, B., Kugler, S., Korošec, M., Polak, T., Bertoncej, J.
Development of low-fat chicken bologna sausages enriched with inulin, oat fibre or psyllium
(2020) *International Journal of Food Science & Technology*, 56 (4), pp. 1818-1828.
- Dingstad, G. I., Kubberød, E., Næs, T., Egelanddal, B.
Critical quality constraints of sensory attributes in frankfurter-type sausages, to be applied in optimization models
(2005) *LWT-Food Science and Technology*, 38 (6), pp. 665-676.
- Zhang, W., Xiao, S., Samaraweera, H., Lee, E. J., Ahn, D. U.
Improving functional value of meat products
(2010) *Meat Science*, 86 (1), pp. 15-31.
- Ch'ng, S. E., Ng, M. D., Pindi, W., Kang, O. L., Abdullah, A., Babji, A. S.
Chicken sausages formulated with gelatin from different sources: A comparison of sensory acceptability and storage stability
(2014) *World Applied Sciences Journal*, 31 (120), pp. 2062-2067.
- Verma, A. K., Sharma, B. D., Banerjee, R.
Effect of sodium chloride replacement and apple pulp inclusion on the physico-chemical, textural and sensory properties of low-fat chicken nuggets
(2010) *LWT-Food Science and Technology*, 43 (4), pp. 715-719.
- Choe, J., Kim, H. Y.
Quality characteristics of reduced fat emulsion-type chicken sausages using chicken skin and wheat fiber mixture as fat replacer
(2019) *Poultry Science*, 98 (6), pp. 2662-2669.
- Fernández-Ginés, J. M., Fernández-López, J., Sayas-Barberá, E., Sendra, E., Pérez-Álvarez, J. A.
Lemon albedo as a new source of dietary fiber: Application to bologna sausages
(2004) *Meat Science*, 67 (1), pp. 7-13.
- Salazar, P., García, M. L., Selgas, M. D.
Short-chain fructooligosaccharides as potential functional ingredient in dry fermented sausages with different fat levels
(2009) *International Journal of Food Science & Technology*, 44 (6), pp. 1100-1107.
- Kang, Z. L., Zhu, D. Y., Li, B., Ma, H. J., Song, Z. J.
Effect of pre-emulsified sesame oil on physical-chemical and rheological properties of pork batters
(2017) *Food Science and Technology*, 37 (4), pp. 620-626.
- Choi, M. S., Choi, Y. S., Kim, H. W., Hwang, K. E., Song, D. H., Lee, S. Y., Kim, C. J.
Effects of replacing pork back fat with brewer's spent grain dietary fiber on quality characteristics of reduced-fat chicken sausages
(2014) *Korean Journal for Food Science of Animal Resources*, 34 (2), p. 158.
- Kılınççeker, O., Kurt, S.
Effects of inulin, carrot and cellulose fibres on the properties of raw and fried chicken meatballs
(2018) *South African Journal of Animal Science*, 48 (1), pp. 39-47.
- Varga-Visi, É., Toxanbayeva, B., Andrásyné Baka, G., Romvári, R.
Textural properties of turkey sausage using pea fiber or potato starch as fat replacers
(2018) *Acta Alimentaria*, 47 (1), pp. 36-43.
- De Angelis, D., Kaleda, A., Pasqualone, A., Vaikma, H., Tamm, M., Tammik, M. L., Squeo, G., Summo, C.

Physicochemical and sensorial evaluation of meat analogues produced from dry-fractionated pea and oat proteins

(2020) *Foods*, 9 (12), p. 1754.

- Souza, C. V. B., Bellucci, E. R. B., Lorenzo, J. M., Barretto, A. C. D. S.
Low-fat Brazilian cooked sausage-Paio-with added oat fiber and inulin as a fat substitute: effect on the technological properties and sensory acceptance
(2019) *Food Science and Technology*, 39, pp. 295-303.
- Andersen, B. V., Brockhoff, P. B., Hyldig, G.
The importance of liking of appearance,-odour,-taste and-texture in the evaluation of overall liking. A comparison with the evaluation of sensory satisfaction
(2019) *Food Quality and Preference*, 71, pp. 228-232.
- Huang, S., Mejía, S. M. V., Murch, S. J., Bohrer, B. M.
Cooking loss, texture properties, and color of comminuted beef prepared with breadfruit (*Artocarpus altilis*) flour
(2019) *Meat and Muscle Biology*, 3 (1), p. 231.
- Garcia-santos, M. D. S. L., Conceicao, F. S., Villas Boas, F., Salotti De Souza, B. M., Barretto, A. C. D. S.
Effect of the addition of resistant starch in sausage with fat reduction on the physicochemical and sensory properties
(2019) *Food Science and Technology*, 39, pp. 491-497.
- Jin, S. K., Ha, S. R., Hur, S. J., Choi, J. S.
Effect of the Ratio of Raw Material Components on the physico-chemical characteristics of emulsion-type pork sausages
(2016) *Asian-Australasian Journal of Animal Sciences*, 29 (2), p. 263.
- Puolanne, E. J., Ruusunen, M. H., Vainionpää, J. I.
Combined effects of NaCl and raw meat pH on water-holding in cooked sausage with and without added phosphate
(2001) *Meat Science*, 58 (1), pp. 1-7.
- Pereira, J., Hu, H., Xing, L., Zhang, W., Zhou, G.
Influence of rice flour, glutinous rice flour, and tapioca starch on the functional properties and quality of an emulsion-type cooked sausage
(2020) *Foods*, 9 (1), p. 9.
- Idris, M. H. H., Manaf, Y. N., Desa, M. N. M., Hashim, A. M., Sani, M. S. A., Zaki, N. N. M., Yuswan, M. H., Mustafa, S.
A conjunction of sn-2 fatty acids and overall fatty acid composition combined with chemometric techniques increase the effectiveness of lard detection in fish feed
(2021) *Chemometrics and Intelligent Laboratory Systems*, 213, p. 104308.

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