Research Article

Effect of Spinach (*Spinacia oleracea*) and Moringa (*Moringa olerifia*) Powder on Physcio-chemical and Sensory Attributes of Chicken Meat Balls

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Abstract

Moringa and spinach is the herbs that nutritious and rich in bioactive compounds. Moringa and spinach leaves powder is the potential to be applied to processed meat products such as meatball. This study was aimed to evaluate the physico-chemical and sensory attributes of chicken meat ball added with moringa and spinach powder. There were 7 levels of treatment employed in the study: Control, which without any addition of moringa or spinach powder, MP 1%, MP 2%, MP 3% and SP 1%, SP2%, SP3% respectively. All ingredients were well blended for preparation of dough and boiled at 80°C for 20 min.The results showed that chicken meat balls incorporated with 2% spinach and 2% moringa powder exhibited higher scores for all the sensory attributes than other treatments. pH of the products differs non-significantly with the treatments. There was significantly increase in cooking yield.

Keywords: Moringa, Spinach, Sensory evaluation, Cooking yield

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Introduction

In a short period of time, the Indian poultry sector transitioned from a mare backyard rearing activity to commercial farming. The poultry industry has far too many other social and economic consequences, such as a slowing of rural-urban migration. The increase in egg and poultry meat production ensures food availability, affordability and security. With the increase in poultry population, the poultry industry has evolved into a dynamic, agro-based activity. Chicken meat and its by products are becoming increasingly popular around the world. Poultry meat is considered relatively inexpensive and there is no social stigma associated with its consumption.

Consumers choose poultry meat because of its inexpensive production costs, low fat content and excellent nutritional value. Fresh frozen, frozen and marinated meat, as well as a variety of comminated meat products such as frankfurters, sausages, bologna, nuggets, burgers and meatballs, are currently available on the market. Poultry meat is a perishable commodity, businesses' primary focus is extending the shelf life of poultry meat [1].

Meatballs are a popular meat-based food in Asia. Meatballs are typically made of minced meat held together by filler and other ingredients such as bread crumbs, spices, and condiments. In East and Southeast Asia, this product is typically prepared and rolled by hand before being boiled and eaten with noodle and sauce. However, in other regions, the meatballs are fried and ready to eat.

Moringa (*Moringa oleifera*) leaf extract is one such promising natural antioxidant source. Moringa leaves have been abundant source of Ascorbic acids, flavonoids, phenolics, carotenoids, Proteins, Calcium, potassium etc. and they act as a Good Natural Antioxidants [2-4]. Leaf extracts from M. oleifera have been verified.as being rich in antioxidants and antimicrobials, activity and had no negative health consequences on human [3, 5]. This tree is native to the United States. India, Pakistan, and Bangladesh have sub-Himalayan tracts. Thailand and the Philippines are both in Southeast Asia [6]

Spinach which is cultivated globally is an important dietary vegetable and a common raw material in the food processing industry. Spinach is a proven source of essential nutrients such as carotene (a precusor of vitamin A) ascorbic acid and several type of minerals [7] Spinach (Spinacia oleracea L.) is an excellent source of health-promoting compounds in the diet. It contains phenolic compounds, primarily patuletin, spinacetin and glucuronide derivatives, which are responsible for its diverse biological and functional properties. Spinach flavonoids have anticancer, antioxidant, amylase, bile acid binding and anti-inflammatory property.

Material and Methods

Raw materials

Broiler of 42 days were procured from the local market, Parbhani, they were slaughtered and dressed according to traditional Halal method at local meat shops. All tendons were removed, separable connective tissues and fat were trimmed off. Dressed meat packed in LDPE pouches was quickly brought to the laboratory, chilled overnight at 4ºC and then frozen at -18ºC for subsequent use. Spinach and Moringa powder procured from Holy Natural Earth Expo Company Gujarat, India. All the chemical used in the present study of analytical grade were procured from standard firms viz., Himedia, Sigma and LobaChemia with food grade commercial salt. Good quality spice ingredients purchased from Parbhani local market. All the spice ingredients were cleaned to remove extraneous matter, dried in hot air oven at 50ºCfor 2 hrs and then ground into a grinder and sieve through through a mesh. Condiments viz, onion, garlic, and ginger were used as condiments. The external covering of onion, garlic and ginger were peeled off and cut into small bits and blended in 3:1: 0.5 ratio using grinder with suitable blade to make into fine paste.

Preparation of chicken meat balls

Chicken meatballs were prepared as per the method of Prabhat *et al*. [8] with slight modification. Meat from broiler chicken after separation of excess fat, tendon, and dirt, etc. was kept at frozen temperature (-18 $\pm 1^0$C) overnight. After adequate thawing at room temperature, cut into small chunks and minced in the meat mincer. After mincing, the minced raw meat with various levels of non-meat ingredients viz., spices, condiments, ice flakes, flour, egg liquid, oil, salt, STPP was mixed in bowl chopper to obtained homogeneous mixture of emulsion.Moringa and spinach powder were added according to the treatment (1%, 2%,3%) and then reground. The homogeneous dough was formed into a round shape and boiled at a temperature of 85°C for 20 minutes. Chicken meatballs after cooling to room temperature was packed in low density polyethylene pouches and immediately served to sensory panellists. Overall quality of products was evaluated on the basis of sensory and physico-chemical characteristics.

Scheme 1. Dough for meat balls Chicken meat balls.

Measurement of quality parameters

Physico-chemical characteristics

pH: The pH of chicken meatballs was determined by the method of Trout *et al* [9]. 10 g of chicken meatballs was made into fine paste with addition of 50 ml distilled water in a laboratory blender. The pH of suspension was measured with the help of digital pH meter (Model: Li 120, ELICO Pvt. Ltd., (Hyderabad) equipped with a combined glass electrode.

Cooking yields: The weight of chicken meatballs was recorded before and after cooking. The yield was calculated and expressed in percentage.

$$\text{Cooking yields (\%)} = \frac{\text{Weight of cooked meatballs}}{\text{Weight of raw meatball}} \text{ X } 100$$

Sensory evaluation: The sensory panellists consisting of academic staffs of the various department were involved to assess the quality of fresh chicken meatballs on the basis of sensory attributes viz., appearance, flavour, juiciness, texture and overall acceptability using 8 point descriptive scale (Keeton,1993) where 8 denoted extremely desirable and 1 1denoted extremely poor.

Result and Discussion

The various levels of spinach and moringa powder were used to prepare acceptable quality chicken meat balls. Spinach and moringa powder were incorporated at different levels (1, 2 and 3%) replacing proportionate amount of emulsion and compared with control chicken meat balls. Various levels of these ingredients were tried and the best level of spinach and moringa powder incorporated was selected on the basis of sensory quality as well as physico-chemical characteristics.

Physico-chemical parameters

pH

The observations with respect to pH and cooking yield of chicken meat balls incorporated with different levels of Moringa powder (1%,2%,3%) are show in graphs 1.

The pH value differs, significantly between control and incorporation of different levels of moringa powder (1%, 2%) However, pH of chicken meat balls incorporated with moringa powder inclined with increase in the level of addition of moringa powder, indicating higher pH values for control chicken meat balls (6.24) and lower pH values (6.11) for incorporation of moringa powder (1%) in chicken meat balls. It may be due to high pH of moringa powder. The result was in close agreement with that of Rahman *et al*., [10] for effect of moringa oleifera leaf extract and synthetic antioxidants on quality and shelf -life of goat meat nuggets at frozen storage.

The pH value differs significantly between control and incorporation of different levels of spinach powder (1%, 2%, 3%) However, pH of chicken meat balls incorporated with Spinach powder inclined with increase in the level of addition of Spinach powder, indicating higher pH values for control chicken meat balls (6.24) and lower pH values (6.11) for incorporation of (1%) spinach powder. The result was in close agreement with that of kim *et al*., [11] for effects of fermented spinach as source of pre-converted Nitrite on color development of cured pork line.

Cooking yield

The cooking yield was significantly increased in chicken meat balls with an increased in the moringa powder level compared to non -formulated chicken meat balls. The cooking yield was increased from 54.60% for non-formulated chicken meat balls to 57.84%, 60.17% and 62.46% for chicken meat balls incorporated with 1, 2 and 3 % moringa powder respectively. Al-juhaimi *et* al., [12] reported similar results for the cooking yield in beef burger formulated with moringa seed flour. The addition of MSF to beef burger improves the cooking yield may be due to fat and water retention capacity and capability to keep moisture in the beef matrix. The results were corroborated with Alakali *et al*., [13] in beef patties formulated with bambara ground nut seed flour.

The cooking yield varied significantly (P≤0.05) between the treatments. Chicken meat balls added with spinach powder 3% level recorded higher (62.69%) cooking yield and the lower (54.60%) cooking yield was observed for control chicken meat balls. The results were corroborated with Alakali *et al*., [13] in beef patties formulated with bambara ground nut seed flour.

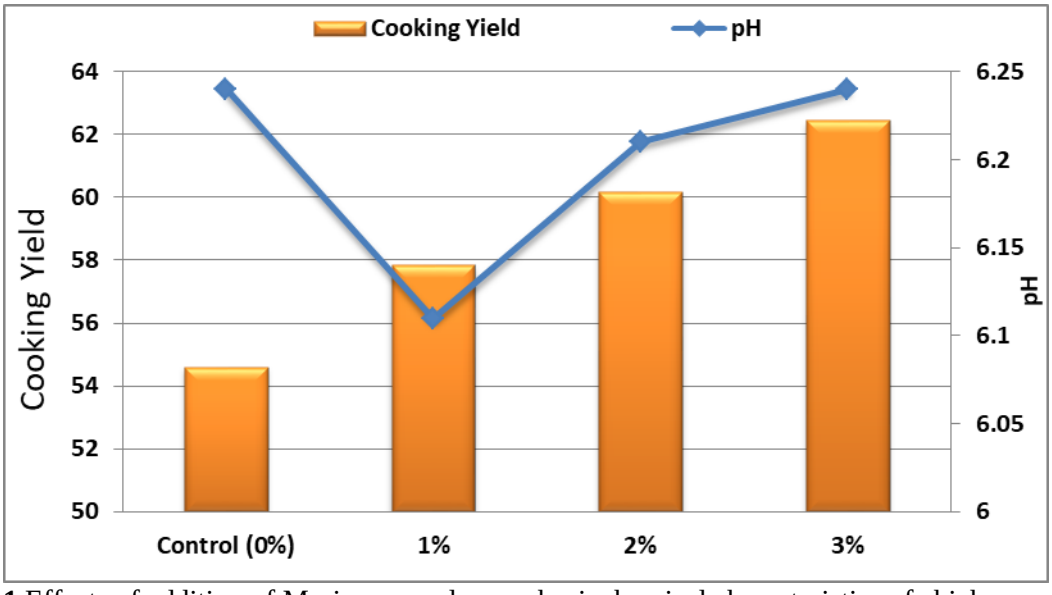

Figure 1 Effects of addition of Moringa powder on physiochemical characteristics of chicken meat balls

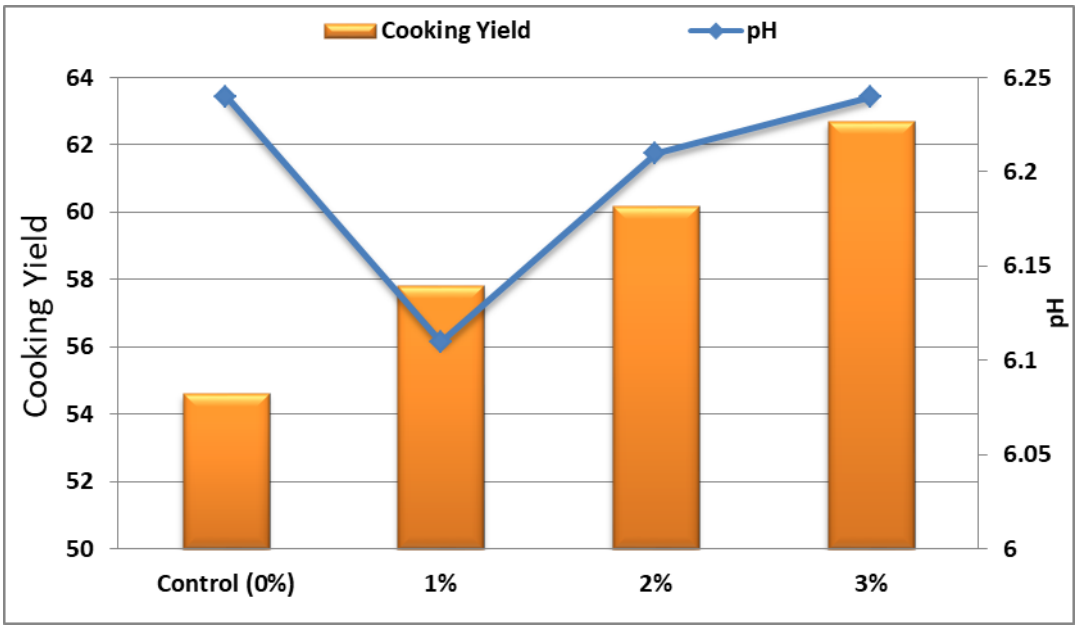

Figure 2 Effects of addition of Spinach powder on physiochemical characteristics of chicken meat balls

Sensory characteristics

The average score with respect to sensory attributes of chicken meat balls incorporated with different levels of moringa powder are shown in **Figure 3**.

It is observed from the Figure 3 that, the chicken meat balls incorporated with 2% moringa powder resulted better score in respect to all sensory attributes as compared to other treatment. It is revealed from observation that incorporation of moringa powder (2%) in chicken meat balls did not differ significantly ($P>0.05$) on appearance score as compare to control chicken meat balls. The highest score was recorded for chicken meat balls incorporated with 2 % moringa powder. Further addition of moringa powder up to 3% score for appearance decreased significantly ($P<0.05$). Similar finding was observed by [14] for chicken sausage added with MOL compared to the controls.

Flavor score of the chicken meat balls incorporated with 2% moringa powder did not differ significantly ($P<0.005$) with control chicken meat balls. Chicken meat balls at 2% level formulations secured significantly ($P<0.05$) higher flavor score (7.44). Further addition of moringa powder up to 3 % flavour score decreased significantly ($P\leq0.05$). Similar findings were observed by Bishoi *et al.*, [15] for preparation of chicken sausages incorporated with Moringa Oleifera leaves extracts.

The sensory score for juiciness does not differ significantly ($p>0.05$) up to the addition of 2% level of moringa powder. Further addition of 3% moringa powder in chicken meat balls scores for juiciness decreased significantly ($P<0.05$) as compared to control chicken meat balls. The higher scores (7.33) were observed in chicken meat balls incorporated with moringa powder at 2 % level and control as compared to other treatments. Present findings are in close agreement with Das *et al*., [3] observed effects of moringa oleiferia leaves extracts at a level of 100 mg/100g in cooked goat meat patties.

Texture scores of chicken meat balls incorporated with moringa powder (2%) did not differ significantly ($P>0.05$) with control chicken meat balls. However, incorporation of moringa powder up to 3% level, scores for texture differ significantly ($P<0.05$) as compared to control and moringa powder added (2%) chicken meat balls, The scores for the texture of chicken meat balls incorporated with 2% moringa powder were highest (7.67) and the least value for texture score (5.44) was observed for chicken meat balls incorporated with 3% moringa powder. Present findings are similar with Solichah *et al*., [16] for evaluation of physicochemical, nutritional and organoleptic properties of nuggets based on moringa (*Moringa oleifera*) leaves and giant catfish (*Arius thalassinus*).

The sensory score for overall palatability of chicken meat balls incorporated with moringa Powder (2%) did not differ significantly ($P\geq0.05$) with control chicken meat balls however addition of moringa powder up to 3% level, score for overall palatability differ significantly ($P<0.05$) as compared to control and moringa powder (2%) added chicken meat balls. Among the treatments the least value (5.67) for overall palatability was observed for chicken meat balls incorporated with 3% moringa powder and highest overall palatability scores (7.33) was recorded for moringa powder chicken meat balls incorporated with 2% moringa powder. The present observations are in close agreement with Muthukumar *et al*., [17] for study of effects of incorporation of moringa oleifera leaves extract on quality of ground pork patties.

It is observed from **Figure 4** that, the chicken meat balls incorporated with 2% spinach powder resulted better scores in respect to all sensory attributes as compared to other treatment. It is revealed from observation that incorporation of spinach powder (2%) in chicken meat balls did not differ significantly (P>0.05) on appearance score as compare to control chicken meat balls. The highest score for appearance was recorded for chicken meat balls incorporated with 2 % spinach powder (7.33). Further addition of spinach powder up to 3%, score for appearance decreased significantly (P<0.05).

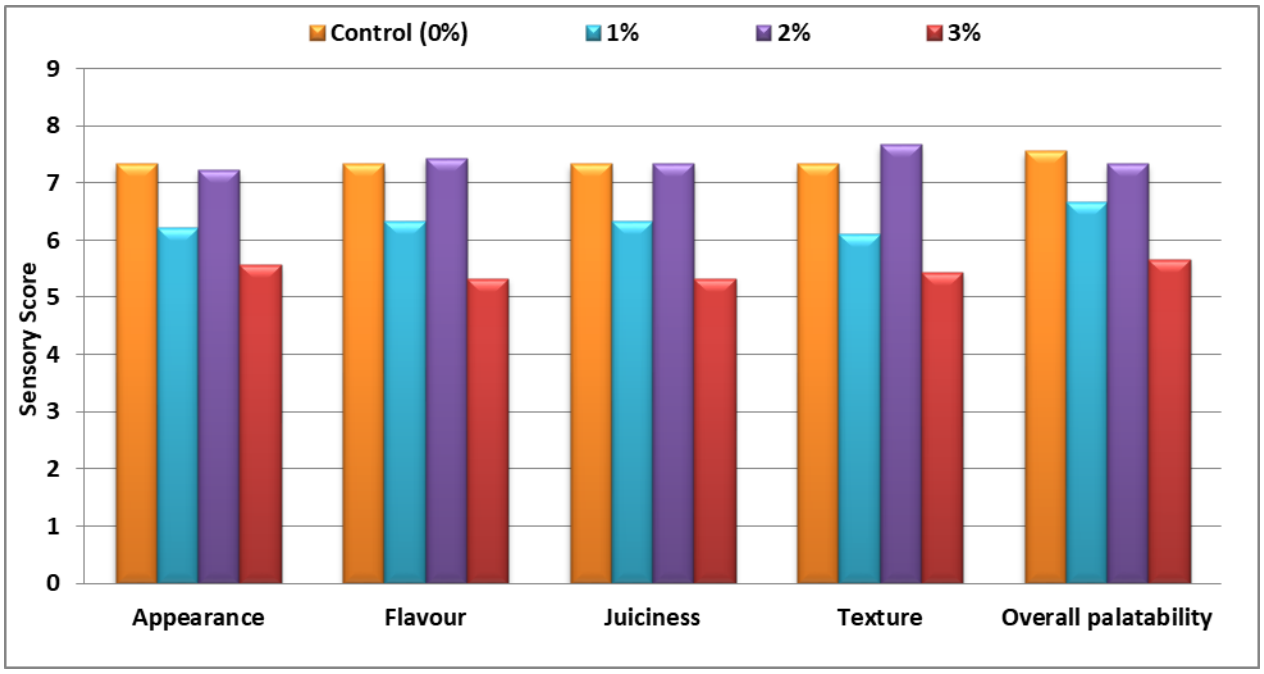

Figure 3 Sensory attributes of chicken meat balls treated with different levels of moringa powder

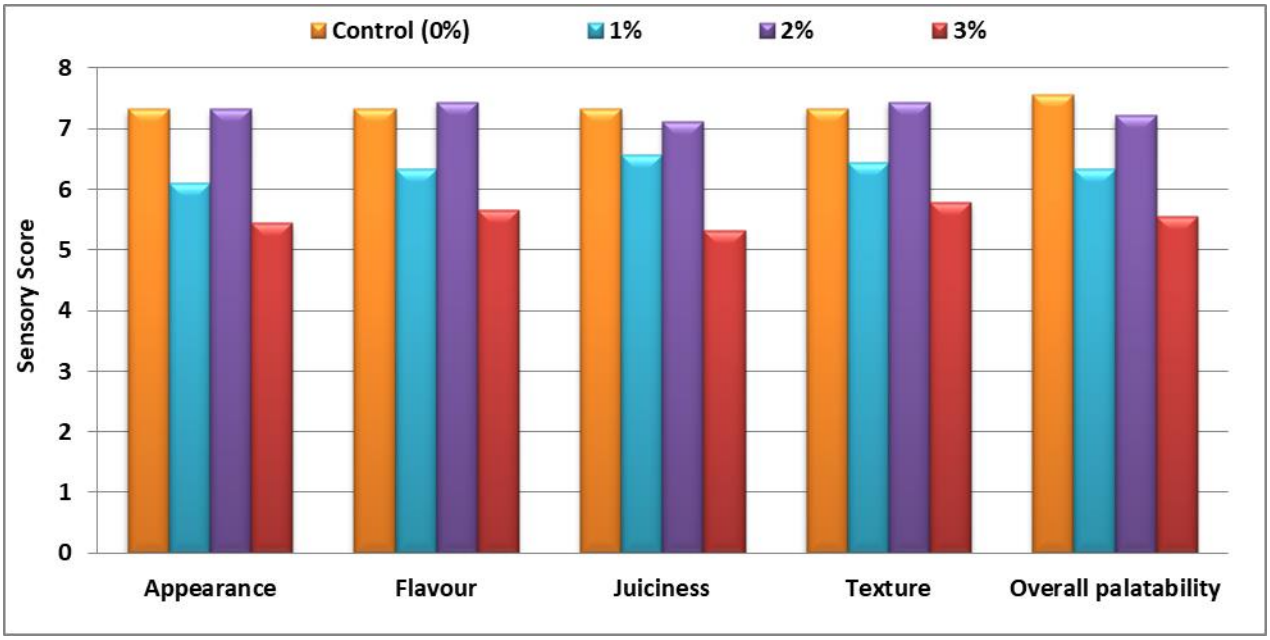

Figure 4 Sensory attributes of chicken meat balls treated with different levels of spinach powder

Flavor score of the chicken meat balls incorporated with 2% moringa powder did not differ significantly (P>0.05) with control chicken meat balls. Chicken meat balls at 2% level formulations secured significantly (P<0.05) higher flavor score (7.44). Further addition of spinach powder up to 3 % flavor score decreased significantly (P< 0.05). The sensory score for juiciness does not differ significantly (P>0.005) up to the addition of 2% level of spinach powder. Further addition of 3% spinach powder in chicken meat balls scores for juiciness decreased significantly (P<0.05) as compared to control and 2% spinach powder added chicken meat balls. The higher scores (7.11) were observed in chicken meat balls incorporated with spinach powder at 2 % level as compared to other treatments.

Texture scores of chicken meat balls incorporated with spinach powder (2%) did not differ significantly (P>0.05) with control chicken meat balls. However, incorporation of Spinach powder up to 1% and 3% level, scores for texture differ significantly (P≤0.05) as compared to control and Spinach powder added (2%) chicken meat balls, The scores for the texture of chicken meat balls incorporated with 2% Spinach powder were highest (7.44) and the least value for texture score (5.78) was observed for chicken meat balls incorporated with 3% spinach powder.The sensory score for overall palatability of chicken meat balls incorporated with spinach Powder (2%) did not differ significantly (P>0.05) with control chicken meat balls however addition of spinach powder up to 1% and 3% level, score for overall palatability differ significantly (P<0.05) as compared to control and spinach powder (2%) added chicken meat balls. Among the treatments the least value (5.56) for overall palatability was observed for chicken meat balls incorporated with 3% spinach powder and highest overall palatability scores (7.22) was recorded for chicken meat balls incorporated with 2% spinach powder.

Conclusion

From the study, it is concluded that the spinach and moringa powder were found useful for improving physico-chemical characteristics of chicken meat balls. The physico-chemical parameters including pH and cooking yield was improved significantly in all treatments than control and highest value recorded for 2% spinach and 2% moringa powder respectively.

References

[1] Celal, T. & A. Bağdatlı, (2017). Use of Natural Antioxidants in Poultry Meat. Celal Bayar University Journal of Science, 13 (2), 279-291

[2] Sreelatha, S., & Padma, P. R. (2009). Antioxidant activity and total phenolic content of Moringa oleifera leaves in two stages of maturity. Plant foods for human nutrition, 64(4), 303-311

[3] Das, A. K., A. S. R. Anjaneyulu, Y.P. Gadekar, R.P. Singh, & H. Pragati, (2008). Effect full-fat soy pastes and textured soy granules on quality and shelf-life of goat meatnuggets in frozen storage. Meat science, 80(3), 607-614.

[4] Dubey, D. K., Dora, J., Kumar, A., &Gulsan, R. K. (2013). A multipurpose tree-Moringa oleifera. International Journal of Pharmaceutical and Chemical Sciences, 2(1), 415-423.

[5] Stohs, S. J., & Hartman, M. J. (2015). Review of the safety and efficacy of Moringaoleifera. Phytotherapy Research, 29(6), 796-804.

[6] Lin, M., Zhang, J., & Chen, X. (2018). Bioactive flavonoids in Moringa oleifera and their health-promoting properties. Journal of functional foods, 47, 469-479.

[7] Ko, S. H., J. H. Park, S.Y. Kim, S.W. Lee, S.S. Chun, & E. Park, (2014). Antioxidant effects of spinach (Spinacia oleracea L.) supplementation in hyperlipidemirats. Preventive nutrition and food science,

[8] Prabhat, R. K. & Sinha, V., (1993). Relationship between ego-strength and job-satisfaction. Indian Journal of Psychometry & Education.

[9] Trout, R., M. I., Taragin, A. P. Wilczek, M. E Karns, & J. L Carson (1992). Physician demographics and the risk of medical malpractice. The American journal of medicine, 93(5), 537-542.

[10] Rahman, M. H., Alam, M. S., Monir, M. M., & Rahman, S. M. E. (2020). Effect of Moringa oleifera leaf extract and synthetic antioxidant on quality and shelf-life of goat meat nuggets at frozen storage. International Journal of Food Research, 7(4), 34-45.

[11] Kim, T. K., Y.B. Kim, K. H. Jeon, J. D. Park, J. M. Sung, J. M., H. W. Choi, & Y.S. Choi, (2017). Effect of fermented spinach as sources of pre-converted nitrite on color development of cured pork loin. Korean journal for food science of anima resources, 37(1), 105.

[12] Al-Juhaimi, F., Ghafoor, K., Hawashin, M. D., Alsawmahi, O. N., &Babiker, E. E. (2016) Effects of different levels of Moringa (Moringa oleifera) seed flour on quality attributes of beef burgers. CyTA-Journal of Food, 14(1), 1-9.

[13] Alakali, J. S., Irtwange, S. V., &Mzer, M. T. (2010). Quality evaluation of beef patties formulated with bambara groundnut (Vigna subterranean L.) seed flour. Meat Science, 85(2), 215-223.

[14] Jayawardana, B. C., R. Liyanage, N. Lalantha, S. Iddamalgoda, &P.Weththasinghe (2015). Antioxidant and antimicrobial activity of drumstick (Moringa oleifera) leaves in herbal chicken sausages. LWT-Food Science and Technology, 64(2),1204-1208.

[15] Bishnoi, S., S. Yadav, M. Ahlawat, A.K. Pathera, & D. P. Sharma, (2019). Optimization of orange peel and Moringa oleifera leaves extract incorporation in chicken sausages. Journalof Pharmacognosy and Phytochemistry, 8(1), 1484-1487.

[16] Solichah, E., Iwansyah, A. C., Pramesti, D., Desnilasari, D., Agustina, W., Setiaboma, W & Herminiati, A. (2021). Evaluation of physicochemical, nutritional, and organoleptic properties of nuggets based on moringa (Moringa oleifera) leaves and giant catfish (Arius thalassinus). Food Science and Technology.

[17] Muthukumar, M., Naveena, B. M., Vaithiyanathan, S., Sen, A. R., & Sureshkumar (2014). Effect of incorporation of Moringa oleifera leaves extract on quality of ground porkpatties. Journal of Food Science and Technology, 51(11), 3172-3180.

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