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Optimization of Ready-to-Cook Chicken Cutlet Mix Using Different Levels of Antioxidant Dietary Fiber Enriched Dehydrated Vegetable Mix

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ABSTRACT

A study was conducted during a period of six (6) months from June to December, 2019 at the Division of Livestock Products Technology, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India to develop a nutritious, convenience and shelf stable ready-to-cook chicken cutlet mix extended with dried vegetables as a source of antioxidant dietary fiber. Dehydrated vegetable mix was added at three different levels (2.5, 5 and 7.5%) and compared with control having no added vegetables. The results revealed that the dehydrated vegetable mix proved to be an additional source of minerals and dietary fibre in the chicken cutlet mix. Extension of ready-to-cook cutlet mix improved the yield, and colour saturation of the mix. The chicken cutlets prepared using the extended mix offered improved juiciness and overall acceptability along with better textural profile. Physico-chemical analysis revealed that the mix was shelf stable due to its low water activity and moisture content and hence could probably be stored for long periods of time. Extension of the mix with DVM enhanced the functionality of the product by improving its antioxidant potential. However, as indicated by sensory evaluation higher levels of dehydrated vegetables (7.5%) altered the colour, texture and flavour of developed product. Hence, 5% level of DVM was found to be the most suitable level for extension of the ready-to-cook mix. Therefore, extension with dehydrated vegetables could serve to meet technological and functional properties in the development of convenient, nutritious and tasty ready-to-cook dehydrated mix, which could serve an alternative to fresh meat cutlets.

KEYWORDS: Ready-to-cook, chicken cutlet, dehydrated vegetables, dietary fiber

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1. INTRODUCTION

In this over-busy socially networked era, instant foods are becoming popular due to their handiness and time saving attributes, besides desire to taste newer products have contributed to their enhanced consumption. These products require mild heating or frying or rehydration in cold or hot water before consumption. Moreover, the rapidly growing urban population with fast-paced city life, increasing number of working couples, increased female workforce and internet savvy younger generation prefer food products, which are easy to prepare, time-saving and adds variety to their routine meals. Convenience is a multifaceted phenomenon (Costa et al., 2001) which suggests that something can be done with reduced effort, just saving time and includes minimizing physical and mental efforts associated with planning and preparing meals (Jackson et al., 2018). Instant foods are a very popular class of convenient foods in view of kitchen convenience as well as meeting the urgent and exigency situation of offering hospitality to unexpected guests. Meat cutlets are crunchy, crispy, energy dense traditional meat treats consumed as snacks to satisfy short term hunger. However, bulky and perishable nature of cutlets limits their role in wide use. Dehydration is an effective way to improve the durability, shelf life besides making them nutrient dense and convenient in terms of storage, handling and transportation due to their smaller volumes. Further extension of such foods with binders such as milk powders and vegetables provide mixture of proteins and other nutrients to the consumer's, desirable from nutrition point of view, and satisfying the consumer's desire for meat (Modi and Prakash, 2008). The use of milk powders such casein, skim milk powder; whey protein has been made in number of products (Barbut, 2010, Jairath et al., 2021). Antioxidant dietary fibers may offer potential multifunctional roles in meat products such as improvement of physico-chemical characteristics, oxidative stability, sensory attributes, shelf life, nutritional composition and improved health benefits (Das et al., 2020).

Dietary fiber is defined as edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine (Anonymous, 2001). High fiber diets are associated with the prevention, reduction and treatment of some diseases, such as diverticular and coronary heart diseases (Hartley et al., 2016), constipation, irritable colon, colon cancer and diabetes (Wendy et al., 2017). Antioxidant activity of vegetables like tomatoes (Joseph et al., 2014), drumsticks (Madane et al., 2019), beetroot (Domínguez et al., 2020) carrots (Singh et al., 2018), beans and peas (Marathe et al., 2011) have been reported due to high phenolic content. Incorporation of vegetables to dehydrated meat products can improve the functionality and technological characteristics of the products. Fibers increase the cooking yield owing to their water and fat retention in meat products (Gibis et al., 2015). Dehydrated vegetables have been added in a number of ready-to-cook food products such as vegetable noodles, soups, casein based instant mix, biscuits with spinach (Narsingh et al., 2017), soup with pumpkin powder (Dhiman et al., 2017). A study on quality changes during the storage of dehydrated chicken *kebab* mix was conducted by Modi et al. (2007). Modi and Prakash (2008) observed that pearl millets, carrots, cabbage, potato and skim milk powder were compatible in the formulation of dehydrated extended meat cubes. Moreover, such products can be easily prepared by small scale entrepreneurs and women co-operatives without any need of sophisticated machinery. The compatibility of vegetables with milk powder as extender in dehydrated meat products is not much known. Hence, the present study was conducted with an objective to standardize the level of incorporation of dehydrated vegetables in a ready-to-cook chicken cutlet mix which could serve the purpose of a consumer friendly, time saving and convenience for today's fast food and snack preferring generation.

2. MATERIALS AND METHODS

2.1. Preparation of RTCCCM

The study was conducted June to December, 2019 at the Division of Livestock Products Technology, Indian Veterinary Research Institute, Bareilly. Spent hen meat (above 72 weeks old) was purchased from Central Avian research institute, Izatnagar, Bareilly and processed in Division of Livestock Products Technology, Indian Veterinary Research institute, Izatnagar, Bareilly, U.P. The meat was deboned, minced in a meat mincer, using 10 mm plate (Mado Eskimo Mew-714, Germany), mixed with sodium tripolyphosphates (0.3 g 100 g^{-1} raw meat) and pressure cooked (15 psi for 30 m). Medium size potatoes were peeled, blanched, soaked in 0.2% potassium metabisulfite ($K_2S_2O_5$) solution for 20 m, shredded and then used in the formulation. Spice mix powder used in the study was prepared by grinding oven dried (60°C for overnight) ingredients *viz.* coriander, cumin seed, aniseed, black pepper, caraway, turmeric, dried ginger, capsicum, cardamom, cinnamon, cloves, nutmeg and mace while condiments such as peeled onions, garlic and ginger were taken in the ratio of 10:2:1 and were made into a fine paste. The cooked meat mince along with other ingredients such as salt, spice mix, condiments, refined wheat flour etc as per the formulation given in Table 1 was blended manually, spread evenly on plates and the resultant mix was dried in a food drier at 60±1°C for 12 h. Clean shredded carrot, beans and green peas were blanched at 60°C for 15 m, shredded or cut into fine pieces and dried in a food drier at 50°C for

8 h. The basic formulation and processing conditions were selected on the basis of preliminary experiments conducted. Thereafter, the dehydrated vegetables i.e. carrot, beans and peas mixed in the ratio (4:3:3) was added to RTCCCM at three different levels (2.5%, 5% and 7.5%) above the level of final formulation. The different batches of obtained mix were then packaged in low density polyethylene bags and analysed for physico-chemical characteristics, antioxidant activity, instrumental colour profile, instrumental texture profile and sensory attributes for selection of optimum level of incorporation of DVM in developed RTCCCM.

Table 1: Formulation of RTCCCM with different levels of dehydrated vegetable mix

Ingredients ('%')	Control	T_1	T_2	T_3
Lean meat	62.5	62.5	62.5	62.5
Salt	1.75	1.75	1.75	1.75
Spice mix	2	2	2	2
Condiments	13	13	13	13
Refined wheat flour	3	3	3	3
Textured soya protein	3	3	3	3
Corn starch	3	3	3	3
Blanched and shredded potato	5	5	5	5
Fermented milk powder	-	7.5	7.5	7.5
Dehydrated vegetable mix (DVM)	-	2.5	5	7.5

Proximate analysis and pH of RTCCCM was determined by Anonymous (1995) procedures and total dietary fiber was determined by method of Furda (1981). Water activity (a_w) was estimated by water activity meter (Hygrolab 3®, Rotronics, Switzerland) while bulk density of the mix was estimated by the procedure of Yetismeyen and Uraz, 2000. Color profile was measured using Hunter Colour Lab set at 2° of cool white light. Texture profile analysis of cooked chicken cutlets from RTCCCM was done using the texturometer (TA-HDi Texture Analyzer, Stable Microsystem Ltd, UK) as per the method of Bourne (1978). Antioxidant activity of the mix was determined by analysing the total phenolic content (Singelton and Rossi, 1965), ABTS radical-scavenging activity (Re et al., 1999) and DPPH radical-scavenging activity as per the method of Brand-Williams et al. (1995). Fresh cutlets were prepared from RTCCCM for conducting sensory evaluations on 8 point descriptive scale where 8= excellent and 1=extremely poor (Keeton, 1983). Data were analyzed statistically on SPSS-16.0 software package as per standard methods (Snedecor, 1994).

2.2. Preparation of cutlet from RTCCCM for sensory evaluation

Fresh cutlets were prepared from RTCCCM for conducting sensory evaluations on 8 point descriptive scale (Keeton, 1983). For this, 100 g of mix was taken, 120 ml of water was added, dough was kneaded, portioned (40 g), moulded into round shaped cutlets, dipped in battering (prepared from reconstituting egg white powder), rolled over breading material uniformly and deep fat fried until a golden-brown colour was developed and a core temperature of 75°C was attained. The evaluation was conducted by a semi trained experienced sensory panel consisting of scientists and post graduate students of Livestock Products Technology Division, Indian Veterinary Research Institute, Izatnagar.

3. RESULTS AND DISCUSSION

3.1. Physico-chemical characteristics

The results of physico-chemical characteristics and proximate composition of RTCCCM incorporated with DVM are presented in Table 2. Addition of DVM to RTCCCM, increased the yield of the product significantly $p<0.05$ and the increase was directly proportional to DVM concentration. The yield of RTCCCM was observed to be much higher than those observed by Nayar et al. (2015) in legume extended dehydrated goat meat cubes. The pH of RTCCCM did not vary significantly ($^*p>0.05$) with the addition of DVM. However, an increase was recorded with increase in level of addition of DVM, which might be due to the alkaline nature of the dehydrated vegetables. aw did not vary significantly ($^*p>0.05$) among the products, although no consistent trend was observed with increase in DVM. The low moisture content and a_w of DVM could have attributed to low a_w level and was well below the limits prescribed for dehydrated foods (0.00–0.65) (Jay et al., 2005). A non-significant ($^*p>0.05$) increase in bulk density of RTCCCM was noted on extension with DVM. The increase might be due to air drying processes that changes the density of materials mainly due to the loss of moisture and formation of air pores. Grigelmo-Miguel et al. (1999) stated that dietary fiber supplementation increases the bulk and prevents cooking loss in meat products which have an economic benefit for both the consumers and processors.

3.2. Proximate composition

A non-significant ($^*p>0.05$) difference was evinced in the moisture content of different batches which might be related to the uniformity in the drying process and the minimum moisture content of DVM. Similar results were noted for fat, protein, ash and carbohydrate content of RTCCCM incorporated with DVM. At 7.5% level slight decrease in fat content was observed, which might be due to the dilution effect of vegetables in the mix. Increase in ash content was observed with higher levels of DVM addition.

Table 2: Physico-chemical and proximate parameters of RTCCCM incorporated with different levels of dehydrated vegetable mix

Parameters	Control	T_1	T_2	T_3
Yield ('%')	48.36± 0.19^d	50.02± 0.78^c	52.23± 0.39^b	54.97± 0.23^a
pH	6.0± 0.02	6.11± 0.02	6.11± 0.01	6.13± 0.05
aw	0.3340± 0.00	0.3310± 0.00	0.3357± 0.00	0.3348± 0.00
Bulk density (g ml^{-1})	0.520± 0.01	0525± 0.01	0.530± 0.01	0.538± 0.01
Cooking yield ('%')	93.84± 0.76	94.08± 0.81	94.17± 0.88	94.51± 0.54
Moisture ('%')	5.52± 0.15	5.52± 0.13	5.53± 0.11	5.53± 0.12
Fat ('%')	8.41± 0.09	8.40± 0.10	8.40± 0.11	8.37± 0.08
Protein ('%')	34.11± 0.96	34.63± 1.38	34.79± 0.77	35.02± 1.41
Ash ('%')	5.40± 0.08	5.40± 0.12	5.46± 0.14	5.50± 0.16
Carbohydrate ('%')	46.75± 0.83	46.09± 1.30	45.61± 0.69	45.43± 1.35
Total dietary fiber ('%')	0.543± 0.08^c	1.96± 0.23b	2.11± 0.16^{ab}	2.56± 0.12^a
Energy (k cal 100 g^{-1})	397.67± 0.55	397.68± 0.54	397.39± 0.80	397.09± 0.70

Control: 0% DVM; T_1: 2.5% DVM; T_2: 5% DVM; T_3: 7.5% DVM; Mean±SE with different superscripts in a row differ significantly (p<0.05), n=6

3.3. *Total dietary fiber (TDF)*

Meat does not contain dietary fiber (Sanchez-Zapata et al., 2010). Incorporation of DVM in the RTCCCM increased the TDF content of the mix with the treatment groups showing significantly ($^*p$<0.05) higher TDF content as compared to the control, which may be attributed to the incorporation of dried shredded carrots, beans and peas. Amongst the treatments, highest TDF was recorded in T_3 followed by T_2 and T_1. However, T_2 had the TDF content comparable to T_1 and T_3. Dietary fiber content in the control mix might be attributed to the presence of soya chunks, spices and condiments. The increased TDF content of RTCCM might also be credited to the addition of partially cooked vegetables, which are noted to have more TDF content as compared to raw vegetables (Li et al., 2002).

3.4. *Instrumental colour profile*

Analysis of colour by hunter colour lab revealed a non-significant ($^*p$>0.05) decrease in L^* value of RTCCCM with the addition of DVM, which might be due to its inherent green and red colour, that would have interfered with the colour of RTCCCM. The a^* and b^* value increased non-significantly ($^*p$>0.05) with the addition of DVM, which may be attributed to the addition of carrots. The results were in agreement with those of Yadav et al. (2018) who reported an increase in a^* and b^* value of chicken sausages prepared with ground and dried vegetables (Table 3).

Table 3: Effect of different levels of dehydrated vegetable mix on the instrumental colour profile of RTCCCM (Mean±SE)

Parameters	Control	T_1	T_2	T_3
L^*	63.14± 1.47	62.46± 1.07	62.17± 1.10	61.73± 0.95
a^*	5.84± 0.20	5.94± 0.24	5.98± 0.13	6.05± 0.09
b^*	16.23± 0.27	16.76± 0.23	16.91± 0.32	17.06± 0.43
Hue	70.17± 0.82	70.40± 0.91	70.46± 0.66	70.45± 0.46
Chroma	17.26± 0.221	17.80± 0.12	17.94± 0.23	18.10± 0.19

Control: 0% DVM; T_1: 2.5% DVM; T_2: 5% DVM; T_3: 7.5% DVM; Mean±SE with different superscripts in a row differ significantly (p<0.05), n=6

With the addition of DVM to RTCCCM, an increase in hue values (Relative position of colour between redness and yellowness) was recorded as compared to control mix, which might be due to the increase in a^* and b^* values of the mix. Kanimozhi (2012) observed an increase in hue values of chicken nuggets incorporated with vegetable paste as compared to untreated samples. Chroma values followed an opposite trend to hue value although no significant ($^*p$>0.05) difference was noted between control and treatments or amongst the treatments. Addition of vegetables in their dehydrated form increased the colour saturation of the mix although it was non-significant ($^*p$>0.05). Similarly, Rocchetti et al. (2020) found that addition of carrot in buffalo meat loaves significantly improved the redness and chroma values.

3.5. *Instrumental texture profile*

The results of textural profile as measured by texture analyser are given in Table 4. Perusal of Table 4 revealed that the incorporation of DVM in chicken cutlets had significant (p<0.05) effects on its textural properties. Control cutlets had significantly (p<0.05) higher hardness mean value than treatment chicken cutlets, which might be due to the lower binding of meat particles due to the presence of vegetables. However, the mean value of cutlets extended with different levels of DVMs did not differ significantly

Table 4: Effect of different levels of dehydrated vegetable mix on the instrumental texture profile of chicken cutlets (Mean±SE)

Parameter	C	T_1	T_2	T_3
Hardness (Nc m^{-2})	185.37± 1.74^a	138.30± 3.03^b	141.11± 8.89^b	122.20± 7.42^b
Springiness (cm)	0.323± 0.01	0.35± 0.02	0.31± 0.02	0.29± 0.01
Cohesiveness	0.203± 0.01	0.19± 0.02	0.19± 0.03	0.18± 0.03
Gumminess (Nc m^{-2})	37.6± 2.28^a	26.59± 0.20^c	29.81± 0.15^b	21.99± 0.88^d
Chewiness (Nc m^{-1})	12.50± 0.45^a	9.31± 0.27^b	9.25± 0.15^b	6.24± 0.26^c
Resilience	0.085± 0.01	0.079± 0.02	0.084± 0.02	0.089± 0.02

Control: 0% DVM; T_1: 2.5% DVM; T_2: 5% DVM; T_3: 7.5% DVM; Mean±SE with different superscripts in a row differ significantly ($p<0.05$), n=6

($p>0.05$) from each other. Saleh and Ahmed (1998) reported that decrease in hardness of extended beef patties with incorporation of carrot and sweet potato might be due to reduction of friction and/or binding among the meat particles. Similar results were recorded by Kanimozhi (2012) in vegetable incorporated chicken nuggets. Springiness and cohesiveness value did not differ significantly ($p>0.05$) among the extended cutlets, and was lower in treatments as compared to control. The lower springiness might be related to the addition of dehydrated vegetables. Similarly, Grigelmo-Miguel et al. (1999) observed that addition of dietary fibre to frankfurters did not affect the springiness and cohesiveness of the product. Gumminess value of control was significantly ($p<0.05$) higher than the extended ones. Among the extended cutlets, T_2 had significantly ($p<0.05$) higher gumminess as compared to T_1 and T_3 with the lowest value in T_3, which might be due to lesser firmness of T_3 based cutlets. Chewiness value of chicken cutlets followed the same pattern as that of gumminess. A significantly ($p<0.05$) lower chewiness was recorded in T_3 as compared to T_2 and T_1 which varied non significantly ($p>0.05$). The decrease in chewiness of treatments could be correlated directly with their hardness. These findings were in agreement with those of Nayar (2012) who observed a direct correlation between gumminess and chewiness with hardness in extended dehydrated meat cubes. The resilience values did not vary significantly ($p>0.05$) amongst control and treatments and was observed to be the lowest in T_1.

3.6. Antioxidant activity

The results of antioxidant activity assay of RTCCCM incorporated with different levels of DVM are presented in Table 5. With an increasing concentration of DVM, a non-significant ($p>0.05$) increase in TPC was observed. However, the increase was quite low which might be due to the addition of vegetables in its shredded form rather than in the form of their phenolic extracts. Similarly, Malav et al. (2015) reported an increase in TPC of mutton patties incorporated with cabbage powder. Incorporation of DVM was thereby found to enhance the functionality of RTCCCM by improving its antioxidant potential. Similarly, high phenolic content in carrots, beans and peas have been reported by Marathe et al. (2011).

Table 5: Effect of different levels of dehydrated vegetable mix on the antioxidant activity of RTCCCM (Mean±SE)

Parameters	Control	T_1	T_2	T_3
Total phenolic content (mg GAE100 g^{-1})	27.45± 0.06	29.02± 0.05	29.98± 0.03	31.18± 0.03
DPPH activity (percent inhibition)	32.98± 2.96	34.01± 2.48	35.08± 1.98	35.99± 1.79
ABTS activity (percent inhibition)	28.00± 0.54	28.62± 1.74	29.04± 0.64	29.99± 0.87

Control: 0% DVM; T_1: 2.5% DVM; T_2: 5% DVM; T_3: 7.5% DVM; Mean±SE with different superscripts in a row differ significantly ($p<0.05$), n=6

The addition of DVM increased the free radical scavenging activity of RTCCCM as revealed by DPPH assay, which might be due to the phenolic, carotenoids and other bioactive compounds in DVM. The results of the present study are well supported by those of Marathe et al. (2011), Xu et al. (2007) and Singh et al. (2018) who have reported low to moderate DPPH scavenging activities in green peas, French beans and carrots.

A trend similar to that observed for DPPH activity was also observed for ABTS radical scavenging activity of RTCCCM. The increase in activity with the concentration of DVM could be well correlated with the addition of vegetables, which were rich sources of bioactive compounds possessing antioxidant activity. Likewise, Llorach et al. (2005) reported a significant increase in ABTS activity of chicken soup functionalised with artichoke, lettuce and cauliflower by-products extract.

3.7. Sensory attributes

Fresh cutlets prepared from RTCCCM incorporated with different levels of DVM were evaluated for various sensory attributes and the results are presented in Table 6. The mean scores for colour and appearance of cutlets prepared from RTCCCM revealed a non-significant ($p>0.05$) difference. DVM incorporated cutlets had higher scores, which increased with the increase in incorporation level

Table 6: Sensory attributes of chicken cutlets prepared from RTCCCM incorporated with different levels of dehydrated vegetable mix (Mean±SE)

Parameters	Control	T_1	T_2	T_3
Colorand appearance (CA)	6.77±0.13	6.85±0.18	6.88±0.21	6.90±0.16
Juiciness	6.47±0.41	6.51±0.49	6.55±0.17	6.60±0.40
Flavor	6.63±0.30b	6.75±0.23ab	6.89±0.18a	6.70±0.20ab
Meat flavor intensity	6.75±0.31	6.70±0.35	6.69±0.42	6.68±0.46
Texture	6.82±0.40	6.80±0.35	6.80±0.35	6.78±0.25
Overall acceptability	6.74±0.22	6.77±0.22	6.80±0.25	6.75±0.25

of DVM. The non-significant (p>0.05) variation in CA might be directly related to the uniform method of cooking of cutlets, which involved frying till the appearance of a golden-brown colour. Furthermore, enrobing of cutlets provided uniformity resulting in non-significant differences.

Similar trend was observed for juiciness amongst the cutlets. The increased juiciness in DVM incorporated products can be attributed to the increased water absorption capacity of blanched vegetables upon rehydration although, the effects were non-significant (p>0.05). Similarly, the compatibility of carrots, cabbage, potatoes in improving the juiciness of dehydrated meat cubes have been documented by Modi and Prakash (2008).

The addition of DVM to RTCCCM improved the flavour of cutlets. Non-significant (p>0.05) difference were recorded between the control, T_1 and T_3 while a significant (p<0.05) difference was recorded between control and T_2 with the higher flavour scores being in T_2. Vegetables improved the flavour of the product although at high levels i.e. T_3 (7.5%) lower sensory scores were obtained, which might be due to the interference of the vegetables during the chewing process. Moreover, larger quantities of vegetables in RTCCCM contributed a prominent beany flavour in the cooked product.

Meat flavour intensity was higher in control as compared to treatments that might have resulted due to the addition of vegetables which would have masked the flavour of meat at higher levels of incorporation.

Chicken cutlets extended with 2.5% and 5% level of DVM had comparatively higher texture score than 7.5% DVM incorporated levels, however statistically, non-significant (p>0.05) difference was observed between treatment cutlets and control cutlets. The texture of the product obtained from sensory scores was in consonance with the results of instrumental texture. Similar results were observed by Kanimozhi (2012) on addition of vegetable grits in chicken nuggets.

Amongst treatments, the lowest overall acceptability was observed in T_3 that might be related to lower texture and interference of the vegetable particles during the chewing process. Overall acceptability of control was non-significantly (p>0.05) lower than treatments. The results were in consonance with those of Modi and Prakash (2008), who reported that addition of carrots and cabbage did not decrease the overall quality of dehydrated meat cubes.

4. CONCLUSION

Addition of DVM improved the antioxidant activity and nutritive value of RTCCCM. The combination of antioxidant dietary fiber, FMP and binders were compatible in the cutlet mix. Incorporation of DVM could meet technological and functional properties in the development of convenient, nutritious and tasty ready-to-cook mixes, which could serve an alternative to fresh meat cutlets. The health benefits of antioxidant dietary fiber incorporation in meat products may open up new possibilities for the industry to address consumer demands.

5. REFERENCES

Anonymous, 1995. Official Methods of Analysis. 16th ed. Rockville, MD, USA.

Anonymous, 2001. The definition of dietary fibre. American Association of Cereal Chemists. Report of the dietary fibre definition Committee to the Board of Directors of the AAC (1)10. Cereal Foods World 46(3), 112–126.

Barbut, S., 2010. Effects of milk powder and its components on texture, yield, and color of a lean poultry meat model system. Poultry Science 89(6), 1320–1324.

Bourne, M.C., 1978. Texture profile analysis. Food Technology 32, 62–66.

Brand-Williams, W., Cuvelier, M.E., Berset, C., 1995. Use of free radical method to evaluate antioxidant activity. LWT Food Science and Technology 28(1), 25–30.

Costa, A.I.A., Dekker, M., Beumer, R.R., Rombouts, F.M., Jongen, W.M.F., 2001. A consumer oriented classification system for home meal replacements. Food Quality and Preference 12, 229–242.

Das, A.K., Nanda, P.K., Madane, P., Biswas, S., Das, A., Zhang, W., Lorenzo, M., 2020. A comprehensive review on antioxidant dietary fibre enriched meat-based functional foods. Trends in Food Science & Technology 99, 323–336.

Dhiman, A., Negi, V., Attri, S., Ramachandran, P., 2017. Development and standardization of instant food mixes from dehydrated pumpkin and pumpkin seed powder (*Cucurbita moschata Duch ex Poir*). International Journal of Bio-resource and Stress Management 8(2), 213–219.

Domínguez, R., Munekata, P.E.S., Pateiro, M., Maggiolino, A., Bohrer, B., Lorenzo, J.M., 2020. Red beetroot. A potential source of natural additives for the meat industry. Applied Science 10, 8340

Furda, I., 1981. Simultaneous analysis of soluble and insoluble dietary fiber. In: James, W.P.T., Theander, Marcel Dekker, O. (Eds.), The Analysis of Dietary Fiber in Foods, 163–172.

Gibis, M., Schuh, V., Weiss, J., 2015. Effects of carboxymethyl cellulose (CMC) and microcrystalline cellulose (MCC) as fat replacers on the microstructure and sensory characteristics of fried beef patties. Food Hydrocolloids 45(2), 236–246.

Grigelmo-Miguel, N., Abadýìas-Serós, M.I., Martýìn-Belloso, O., 1999. Characterisation of low-fat high-dietary fibre frankfurters. Meat Science 52(3), 247–256.

Hartley, L., May, M.D., Loveman, E., Colquitt, J.L., Rees, K., 2016. Dietary fibre for the primary prevention of cardiovascular disease. Cochrane Database of Systematic Reviews 1, 1–78.

Jackson, P., Brembeck, H., Everts, J., Fuentes, M., Halkier, B., Hertz, F.D., Meah, A., Viehoff, V., Wenzl, C., 2018. Convenience food as a contested category. In: Reframing Convenience Food. Palgrave Macmillan, Cham.

Jairath, G., Sharma, D.P., Dabur, R.S., Singh, P.K., Pathera, A., 2021. Optimization and quality evaluation of buffalo calf meat sausages incorporated with skim milk powder as a complete fat replacer. Buffalo Bulletin 40(4), 625–636.

Jay, J.M., Loessner, M.J., Golden, D.A., 2005. Modern food microbiology, 7th ed. Springer (India) Private Limited, 443–447.

Joseph, S., Chatli, M.K., Biswas, A.K., Sahoo, J., 2014. Oxidative stability of pork emulsion containing tomato products and pink guava pulp during refrigerated aerobic storage. Journal of Food Science and Technology 51(11), 3208–3216.

Kanimozhi, R.K., 2012. Studies on incorporation of selected vegetables and herbs on the quality of chicken nuggets. PhD Thesis submitted to Deemed University IVRI, Izatnagar, U.P.

Keeton, J.T., 1983. Effect of fat and NaCl/phosphate levels on the chemical and sensory properties of pork patties. Journal of Food Science 48(3), 878–881.

Li, B.W., Andrews, K.W., Pehrsson, P.R., 2002. Individual sugars, soluble, and insoluble dietary fiber contents of 70 high consumption foods. Journal of Food Composition and Analysis 15(6), 715–723.

Llorach, R., Tomas-Barberan, F.A., Ferreres, F., 2005. Functionalisation of commercial chicken soup with enriched polyphenol extract from vegetable by-products. European Food Research Technology 220(1), 31–36.

Madane, P., Das, A.K., Pateiro, M., Nanda, P.K., Bandyopadhyay, S., Jagtap, P., Barba, F.J., Shewalkar, A., Maity, B., Lorenzo, J.M., 2019. Drumstick (*Moringa oleifera*) flower as an antioxidant dietary fibre in chicken meat nuggets. Foods 8, 307.

Malav, O.P., Sharma, B.D., Kumar, R.R., Talukder, S., Ahmed, S.R., 2015. Antioxidant potential and quality characteristics of functional mutton patties incorporated with cabbage powder. Nutrition and Food Science 45(4), 542–563.

Marathe, S.A., Rajalakshmi, V., Jamdar, S.N., Sharma, A., 2011. Comparative study on antioxidant activity of different varieties of commonly consumed legumes in India. Food Chemistry and Toxicology 49(9), 2005–2012.

Modi, V.K., Prakash, M., 2008. Quick and reliable screening of compatible ingredients for the formulation of extended meat cubes using Plackett–Burman design. LWT Food Science and Technology 41(5), 878–882.

Modi, V.K., Sachindra, N.M., Nagegowda, P., Mahendrakar, N.S., Narasimha Rao, D., 2007. Quality changes during the storage of dehydrated chicken kebab mix. International Journal of Food Science and Technology 42(7), 827–835.

Narsingh, R.G., Prabhakarara, R.P., Balaswamy, K., Math Rudrayya, G., Satyanarayana, A., 2017. Nutritional, textural and sensory quality of biscuits supplemented with spinach (*Spinacia oleracea* L.). International Journal of Gastronomy and Food Science 17(7), 20–26.

Nayar, R., 2012. Development and quality evaluation of extended and dehydrated goat meatcubes. PhD Thesis submitted to Deemed University, IVRI, Izatnagar, U.P.

Nayar, R., Mendiratta, S.K., Prabhakaran, P.P., Chand, S., Sharma, B.D., 2015. Development and comparison of shelf stable extended and dehydrated goat meat cubes containing four different legume based binder mixes. Journal of Food Science and Technology 52(7), 4515–4522.

Re, R., Pellegrini, N., Proteggente, A., Pannala, A., Yang, M., Rice-Evans, C., 1999. Antioxidant activity applying an improved ABTS radical cation decolorization assay. Free Radical Biology and Medicine 26(9–10), 1231–1237.

Rocchetti, G., Pateiro, M., Campagnol, P.C., Barba, F.J., Tomasevic, I., Montesano, D., Lucini, L., Lorenzo, J.M., 2020. Effect of partial replacement of meat by carrot on physicochemical properties and fatty acid profile of fresh turkey sausages: a chemometric approach. Journal of the Science of Food and Agriculture 100, 4968–4977.

Saleh, N.T., Ahmed, Z.S., 1998. Impact of natural sources rich in provitamin A on cooking characteristics, color, texture and sensory attributes of beef patties. Meat Science 50(3), 285–293.

Sánchez-Zapata, E., Munoz, C.M., Fuentes, E., Fernandez-Lopez, J., Sendra, E., Sayas, E., Navarro, C., Perez-Alvarez, J.A., 2010. Effect of tiger nut fibre on quality characteristics of pork burger. Meat Science 85(1), 70–76.

Singh, B.K., Koley, T.K., Maurya, A., Singh, P.M., Singh, B., 2018. Phytochemical and antioxidative potential of orange, red, yellow, rainbow and black coloured tropical carrots (*Daucus carota* subsp. *sativus Schubl.* & Martens). Physiology and Molecular Biology of Plants 24(5), 899–907.

Singleton, V.L., Rossi, J.A., 1965. Colorimetry of total phenolics with phosphomolybdic phosphotungstic acid reagents. American Journal of Enology and Viticulture 16(3), 144–158.

Snedecor, G.W., Cochran, W.G., 1994. Statistical methods, 8th edn, Iowa State University press, Iowa.

Wendy, J.D., Nicole, C.A., Asa, M.E., Kaley, L.M., Joseph, D.O., Carley, T.R., Carly, N.Y., 2017. Health benefits of fiber fermentation. Journal of the American College of Nutrition 36(2), 127–136.

Xu, B.J., Yuan, S.H., Chang, S.K.C., 2007. Comparative analyses of phenolic composition, antioxidant capacity, and color of cool season legumes and other selected food legumes. Journal of Food Science 72(2), S167–S177.

Yadav, S., Pathera, A.K., Islam, R.U., Malik, A.K., Sharma, D.P., 2018. Effect of wheat bran and dried carrot pomace addition on quality characteristics of chicken sausage. Asian-Australasian Journal of Animal Science 31(5), 729.

Yetismeyen, A., Uraz, T., 2000. Properties of dried milk made from cow, ewe and goat milk. Milchwissenschaft 55(5), 270–272.