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Effect of ginger extract on sensory quality of spent Japanese quail meat tandoori

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Abstract

Spent Japanese quail (SJQ) meat was tenderized with ginger extract and utilized in the preparation of tandoori. The ginger extract level for tenderization of SJQ meat was optimized by physico-chemical and sensory analyses. The SJQ meat was treated with two levels of ginger extract and used for tandoori preparation along with two controls (broiler quail meat and spent quail meat). Japanese quail tandoori was prepared as four treatments namely CYB (Control young broiler), CSA (Control spent adult), G20 (Spent adult - ginger treatment 20%) and G40 (Spent adult - ginger treatment 40%). The aqueous ginger extract was prepared from fresh ginger rhizome (Zingiber officinale Roscoe). The SJQ was marinated in ginger extract marinade, tumbled, and placed in the chiller (4±1^{0}C) for 24 hours and utilized for tandoori preparation. The cooked tandoori of all the treatments were analysed for the physico-chemical and sensory parameters. With ginger extract marination, the pH of cooked tandoori was not affected and the product yield was improved. In the organoleptic evaluation, the appearance score increased in the treatment with 20% ginger extract. The flavour score was significantly ($p<0.05$) higher in CYB and G20. The SJQ was significantly ($p<0.05$) tenderized by treatment with 20% and 40% ginger extract. CYB and G20 had significantly ($p<0.01$) higher scores for overall acceptability scores. It is concluded that 20% ginger extract level could effectively be used to tenderize the SJQ meat for the preparation of tandoori without affecting the physico-chemical and sensory properties.

Keywords: *Spent Japanese quail meat, tenderization, ginger extract, sensory quality*

In recent years Japanese quail meat has been gaining much popularity among consumers. In parallel, farmers are interested in Japanese quail farming and hence there is a gradual increase in the Japanese quail population, especially in South India. Since Japanese quails are suitable for egg and meat production, commercial quail farming in India can be a great source of substantial income and employment opportunity. Climate of India is more suitable for Japanese quail production. Japanese quail meat is one of the most desired alternative poultry meat among the consumers, since

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it has less fat content with more of phospholipids. Though Japanese quail meat has a good market throughout the year, producers face difficulties in disposing the spent Japanese quails. Since, the eating quality of spent meat is less in terms of tenderness, consumers do not prefer such tough meat. Hence, the producers are forced to dispose them at cheaper rates. Utilization of meat from spent birds had been demonstrated previously by preparing duck meat sticks (Sangilimadan *et al*., 1998) and chicken meat pickle (Murugan *et al*., 2002).

Tenderizing the spent Japanese quail meat would decrease the toughness and preparing tandoori from tenderized meat is a method of value addition which would increase the market rate of the spent quails. Many enzymes such as papain, bromelain, and ficin are being used commercially for meat tenderization. In recent times, plant proteases such as actinidin and zingibain, and microbial enzyme preparations are gaining interest for meat tenderization. Ginger contains protease enzyme zingibain which is a thiol proteinase. It has proteolytic activity on collagen and actomyosin and the combined proteolysis of these two muscle proteins aids in the meat tenderization (Thompson *et al*., 1973). Yet, it would be economical and easier to use ginger in tenderizing spent Japanese quail meat. The efficacy of ginger as a tenderizing agent for meats had been studied (Reshi *et al*., 2017; Saranya *et al*., 2017; Jafari *et al*., 2020) and reviewed (Saranya *et al*., 2016). Since ginger is a part and parcel of the Indian cookery, its addition would not affect the sensory quality of meat. This tenderized meat could be used in the regular cuisine.

Tandoori is a popular food item in India normally prepared from chicken meat which is conventionally prepared in a cylindrical clay oven known as tandoor. The product has a unique flavour and taste with a bright red colour imparted by the chilli powder used. Usually, curd is used in tandoori preparation along with the other condiments and spices. This study was carried out to prepare tandoori from the spent Japanese quail meat tenderized with the ginger extract and to evaluate its physico-chemical and sensory properties.

Materials and methods

Japanese quail meat

Meat of Japanese quail collected from birds of two age group (young broiler quail about 8 weeks of age and spent quail about 8 months of age) were used in the experiment. Dressed Japanese quail carcasses were procured from the farm of Veterinary College and Research Institute, Namakkal. The carcasses were hygienically trimmed by removing all the connective tissues at the department laboratory. The deboned meat was packaged in low-density polyethylene bags stored in the laboratory freezer at -18±2°C for subsequent use in the experiments.

Preparation of ginger extract

Ginger extract was prepared in two concentrations containing 200 gm ginger in 800 ml water (20%) and 400 gm ginger in 600 ml water (40%). Fresh ginger rhizome (*Zingiber officinale Roscoe*) was procured from the local market, washed thoroughly, peeled, sliced and blended with the potable water in mixer-grinder for about 1 to 2 min. The homogenate was squeezed through 4 layers of muslin cloth. The extract was stored in a refrigerator at 4±1°C overnight and the supernatant was collected used for further experiments as the ginger extract. Fresh ginger extract was prepared for each trial.

Tandoor marinade ingredients

Curd prepared from standardized and homogenized milk was purchased from the local market. The spice mix ingredients viz., salt, turmeric powder, chilli powder and lemon procured from the local market were used throughout the study. The condiments mix was prepared by taking ginger and garlic in the ratio of 1:1, made into paste form and used as condiment mixture.

Preparation of Japanese quail tandoori

Tandoori marinade mix formulation

The basic formulation for the marinade mix for the Japanese quail tandoori given in

Table 1. Formulation of tandoori marinade for 1 Kg of meat

Ingredients	Amount
Curd	1000 g
Salt	50 g
Turmeric powder	5 g
Chilli powder	30 g
Ginger garlic paste	50 g
Lemon juice	5 ml

Table 1 was standardized after preliminary trials. This formulation was used per 1000 g of meat.

Experimental design

Fresh ginger extract was used to tenderize spent Japanese quail meat and the meat was utilized in the preparation of tandoori. The spent Japanese quail meat was treated with two levels of ginger extract and used for tandoori preparation along with two controls (broiler quail meat and spent quail meat). Japanese quail tandoori was prepared as four treatments namely CYB (Control young broiler), CSA (Control spent adult), G20 (Spent adult - ginger treatment 20%) and G40 (Spent adult - ginger treatment 40%). The ginger extract level for tenderization of spent quail meat was optimized by performing physico-chemical and sensory analyses.

Cooking of Japanese quail tandoori meat

The frozen Japanese quail meat was tempered to 4°C by keeping in refrigerator overnight and used for the preparation of tandoori meat. The quail meat were marinated in the tandoori marinade mix for about eighteen hours in the chiller temperature (4±1°C). Excess marinade was drained at room temperature (20±1°C) for about 20 minutes and cooked in gas tandoor for until core temperature of 82°C was attained.

Preparation of Japanese quail tandoori from ginger extract treated spent Japanese quail meat

Four treatments as per the experimental design was prepared and meat for G20 and G40 treatments were prepared by marinating the spent quail meat in the 20% and 40% ginger extracts (1000 ml per kg of meat) followed by tumbling for 20 minutes, leaving in the chiller (4±1°C) for 24 hours and draining at room temperature for about 10 minutes. The meat for all the four treatments were marinated in the tandoori marinade mix and tandoori was prepared as per the procedure explained previously.

Analyses of Physico-chemical parameters

The pH of tandoori was determined by adopting the method of AOAC (1995). For measuring pH of the product, 5 g of sample was homogenized with 45 ml of distilled water by using tissue homogenizer (Polytron PT 3100, Switzerland) for about 1 minute. The pH of the homogenate was recorded by immersing combined glass electrode and temperature probe of the digital pH meter (Model 361, Systronics, India).

Initial weight of raw meat and weight of cooked tandoori were recorded. The product yield was calculated as below

$$\text{Product yield (\%)} = \frac{\text{Weight of cooked tandoori X 100}}{\text{Weight of the raw meat}}$$

Analyses of sensory quality parameters

Semi-trained sensory panel consisting of students (6 no.) and teaching faculty (6 no.) of the college evaluated the products. Samples were evaluated for appearance, flavour, juiciness, tenderness, and overall acceptability scores using 8- point hedonic scale (Keeton, 1983). Coded samples were served warm to the panelists in the sensory laboratory with suitable illumination. Drinking water was provided for oral rinsing between the samples.

Statistical analysis

The data generated in the present study were subjected to statistical analysis for analysis of variance, critical difference and Duncan's multiple range test was done for comparing the means to find the effect of treatment using the statistical software SPSS for windows version 15.0.

Results and discussion

Product pH

Product pH did not differ significantly among the treatments (Table 2). In concurrence with this result, Naveena *et al*. (2004) did not notice any difference in the pH between the buffalo meat chunks with and without ginger extract treatment. Similarly, tenderization of camel meat with ginger extract at concentrations of 15%, 30% and 45% did not affect the cooked product pH (Abdeldaiem *et al*., 2014).

Product yield

Product yield percentage was 76.70±0.29, 76.11±0.49, 77.82±0.37 and 79.79±1.16 for CYB, CSA, G20 and G40 respectively. G40 had significantly ($p<0.05$) higher value than CYB and CSA, and comparable with G20 whereas CYB, CSA and G20 were significantly similar (Table 2). In this study the ginger extract treatment improved the cooking yield. In agreement with this, Abdeldaiem *et al*. (2014) also observed an increase in cooking yield of camel meat with increase in the concentration of ginger extract. Similarly, Naveena *et al*. (2004) reported enhanced cooking yield of buffalo meat when treated with 5% ginger extract which might be due to the improved water holding capacity as noticed by them. Naveena and Mendiratta (2001) witnessed an insignificant increase in the cooking yield of spent hen breast meat chunks when treated with ginger extract. Raw rabbit meat treated with ginger extract for 48 hours reduced the cooking loss (Doneva *et al*., 2018).

Appearance score

Appearance scores were 7.10±0.07, 6.90±0.15, 7.50±0.17 and 6.60±0.16 for CYB, CSA, G20 and G40 respectively (Table 3). G20 had significantly ($p<0.05$) higher scores followed by CYB. G40 had significantly ($p<0.05$) lower scores than CYB whereas CSA was comparable with CYB and G40. It was observed by the sensory panelists that the appearance of the product surface was similar in CYB, CSA and G20, whereas in G40, due to over tenderization, the muscle fibres at some areas lost the orientation and seen detached from the surface due to cooking. The inner meat was pinkish red in colour in ginger treated products whereas in the CYB and CSA it was pale. Similar to our findings, Abdeldaiem *et al*. (2014) reported that the appearance and colour scores increased with ginger extract treatment where the ascending concentrations of ginger extract caused bright pink-red colour of camel meat chunks which might be due to the effect of ginger extract compounds on pigment of camel

Table 2. Effect of ginger extract marination of spent Japanese quail meat on the physico-chemical parameters of tandoori preparation (Mean±SE[#])

Physico-chemical parameters	Treatments				Significance of treatment effect[##]
	CYB	CSA	G20	G40	
Product pH	5.68±0.05	5.65±0.04	5.67±0.04	5.69±0.01	NS
Product Yield (%)	76.70^{b}±0.29	76.11^{b}±0.49	77.82^{ab}±0.37	79.79^{a}±1.16	*

Means in a row with different superscripts are significantly different
[#]Standard error of the mean [##]Significance of treatment effect: *P <0.05, NS- Not Significant
No. of observations - n = 6
CYB - Control young broiler CSA - Control spent adult
G20 - Spent Adult treated with Ginger extract 20% G40 - Spent Adult treated with Ginger extract 40%

meat samples. Naveena and Mendiratta (2001) found that the appearance score of spent hen meat was improved on treating with ginger extract.

Flavour score

Flavour score was 7.25±0.13, 6.55±0.17, 7.20±0.20 and 5.70±0.17 for CYB, CSA, G20 and G40 respectively (Table 3). CYB and G20 had significantly ($p<0.01$) higher scores followed by CSA whereas G40 had least value. In concurrence with our results, Abdeldaiem 2014) observed improved flavour in camel meat treated with 15% and 30% ginger extract and decreased in meat treated with 45% ginger extract. Treatment of spent hen meat with 3% ginger extract (Naveena and Mendiratta, 2001) and buffalo meat with 5% ginger extract (Naveena *et al*., 2004) improved the flavour scores.

Tenderness score

Tenderness score was 6.80±0.25, 6.15±0.11, 7.00±0.21 and 6.75±0.21 for CYB, CSA, G20 and G40 respectively (Table 3). CSA had significantly ($p<0.05$) lower scores and the other three treatments were comparable. Similar to this study, Naveena and Mendiratta (2001) observed higher tenderness scores for spent hen meat treated with 3% ginger extract. In another study, buffalo meat tenderized with 5% ginger extract significantly increased the tenderness scores in the sensory evaluation (Naveena *et al*., 2004). Anandh *et al*. (2011) found that the sensory scores for tenderness were significantly higher for 5.0% ginger extract treated smoked buffalo rumen meat product. Abdeldaiem *et al*. (2014) treated camel meat with 15%, 30% and 45% ginger extract which improved its tenderness score. Proteases present in the ginger extract is responsible for increasing the collagen solubility thereby improving the tenderness (Moon, 2018) and yield of drier meat cuts (Cruz *et al*., 2020).

Juiciness score

Juiciness scores were 6.60±0.27, 5.95±0.12, 6.60±0.26 and 6.35±0.21 for CYB, CSA, G20 and G40 respectively with no significant difference among the treatments (Table 3 and 4). The value for juiciness ranged from 5.95 to 6.60 and there was no significant difference among the samples. The highest score was noted for CYB (6.60) and the lowest noted for CSA (5.95). Abdeldaiem *et al*. (2014) noticed improved juiciness scores for camel meat on treating with 15%, 30% and 45% ginger extract. The juiciness scores of the spent hen meat increased on increasing the concentration of ginger extract from 1% to 5% (Naveena *et al*., 2004). Pasteurized canned meat prepared with ginger rhizome was evaluated to be juicier and softer than control (Draszanowska *et al*., 2020).

Table 3. Effect of ginger extract marination of spent Japanese quail meat on the sensory parameters of tandoori preparation (Mean±SE[#])

Sensory Quality parameters	Treatments				Significance of treatment effect[##]
	CYB	CSA	G20	G40	
Appearance score	7.10^{b}±0.07	6.90^{bc}±0.15	7.50^{a}±0.17	6.60^{c}±0.16	*
Flavour score	7.25^{a}±0.13	6.55^{b}±0.17	7.20^{a}±0.20	5.70^{c}±0.17	**
Tenderness score	6.80^{a}±0.25	6.15^{b}±0.11	7.00^{a}±0.21	6.75^{a}±0.21	*
Juiciness score	6.60±0.27	5.95±0.12	6.60±0.26	6.35±0.21	NS
Overall acceptability score	6.80^{a}±0.13	6.00^{b}±0.11	7.00^{a}±0.20	6.00^{b}±0.13	**

Means in a row with different superscripts are significantly different
[#]Standard error of the mean [##]Significance of treatment effect: *p<0.05, **p<0.01, NS- Not Significant
No. of observations - n = 6
CYB - Control young broiler CSA - Control spent adult
G20 - Spent Adult treated with Ginger extract 20% G40 - Spent Adult treated with Ginger extract 40%

Overall acceptability score

Overall acceptability score was 6.80±0.13, 6.00±0.11, 7.00±0.20 and 6.00±0.13 for CYB, CSA, G20 and G40, respectively (Table 3). CYB and G20 had significantly higher scores followed by CSA and G40 where the latter two treatments were statistically similar with lower scores of "Moderately acceptable" level. The result showed that the 20% ginger extract would be an optimum level for tenderization of spent quail meat without affecting much the sensory qualities. In this study, the 20% ginger treatment was at par with the broiler control meat product. Similar to this, based on the sensory evaluation, Abdeldaiem *et al*. (2014) recommended that cooked camel meat treated with 30% ginger extract was rated superior and most preferred by the panelists and appeared to be the optimum level to achieve the best tenderization effect, with desirable ginger flavour. Treatment of spent hen meat with 3% ginger extract (Naveena and Mendiratta, 2001) and buffalo meat with 5% ginger extract (Naveena *et al*., 2004) improved the overall acceptability scores. Spent hen breast meat sausage treated with 2% ginger extract showed improved overall acceptability scores compared to that of untreated spent hen meat sausage and broiler breast meat sausage (Hossain *et al*., 2021). Organoleptically acceptable products such as meat rolls with 5% ginger extract (Parkash *et al*., 2021) and chicken nuggets with 1% ginger extract (Khatun *et al*., 2022) had been recently developed with good acceptability.

Conclusion

The spent quail meat was significantly tenderized by treating with 20% and 40% ginger extract. Based on the present study, it was concluded that the ginger extract at 20% level could be effectively used for tenderizing the spent Japanese quail meat and the meat could be effectively used for the preparation of tandoori without affecting the physico-chemical and sensory properties.

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Conflict of interest

The authors declare that they have no conflict of interest.

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