

Effect of Ash Gourd (*Benincasa hispida*) on Textural Characteristics, Colour Profile and Cost of Production of Duck Meat Loaves

Jyotishka Kumar Das¹, Mineswar Hazarika², Ankur Das³, Masuk Raquib^{4*}, Dhruba Jyoti Kalia⁵ and Naba Nahardeka⁶

¹Ph.D scholar, Department of Livestock Products Technology, ICAR- Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh, INDIA

²Professor & Head, Department of Livestock Products Technology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam, INDIA

³Assistant Professor, Department of Livestock Products Technology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam, INDIA

⁴Assistant Professor, Department of Livestock Products Technology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam, INDIA

⁵Professor & Head, Department of Biochemistry, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam, INDIA

⁶Chief Scientist, Goat Research Station, Assam Agricultural University, Burnihat, Assam-793101, INDIA

*Corresponding Author: masuk.raquib@aau.ac.in

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Abstract

Duck meat processing has not gained much momentum compared to that of chicken, hence, processing duck into communitated value added meat products may offer better returns to the producers. Duck meat loaves were prepared by incorporation of ash gourd (*Benincasa hispida*) at 5.0, 7.5 and 10.0 per cent, respectively and were subjected to colour and textural profile analysis. Based on the existing market rate of raw materials, the cost of production for the preparation of duck meat loaves was also estimated. Non-significant ($P>0.05$) difference was observed for textural characteristics (hardness, fracturability, springiness, cohesiveness, gumminess, chewiness and resilience) and colour profile of duck meat loaves due to incorporation of ash gourd at different levels. Cost of production was found to be highest in T1 group (Rs. 512 /kg) and the cost decreased with increase in the incorporation level of ash gourd. Based on the results and the diet atlas of Assamese society it can be concluded that ash gourd (*Benincasa hispida*) can be successfully used as replacement for meat without any effect on color and texture in ready-to-eat convenient duck meat products.

Keywords: Ash Gourd, Colour Profile, Communitated Meat, Duck, Texture Characteristics

Introduction

Duck rearing forms an integral part of livelihood for rural farmers in Assam. With a population of 4.72 million ducks throughout the length and breadth of the State, it ranks 2nd among Indian states in duck population (Department of Animal Husbandry and Fisheries, 2012). Duck farming is a lucrative job among the weaker sections of rural masses providing supplementary and steady income along with much needed animal source protein from duck eggs and meat. The topography of Assam with many water bodies, marshy river sides, wetlands and barren moors provides a conducive atmosphere for duck rearing in the state. Assam at present is producing around 16.65 tonnes of duck meat in the state annually (Economic Survey of Assam, 2014).

Duck meat is preferred by the people of Assam since ages with no religious and social taboo in consumption of duck meat. Out of the different strains of duck popular in India viz., Nageswari, Khaki Campbell, Cinahanh (Muscouvy), Rajhanh and Pati, the later is most preferred meat among the rural consumers (Mahanta *et al.*, 2001). Duck meat is considered both as red and white meat containing high levels of phospholipids, monounsaturated fatty acids especially oleic acid and linolenic acids which constitute about 60% of total fatty acids (George *et al.*, 2014). Due to perceived high risk of cardiovascular diseases associated with red meat, the consumption of white meat including duck meat is gaining more popularity in recent years. In meat processing sector, duck meat has not gained much momentum due to its inherent toughness as compared to that of chicken. Hence, processing duck meat into communitated value added meat products may offer better alternative to utilize the ducks thereby paving a way to get better returns to the producers. There are reports which testify the fact that the tribal communities have been preparing certain duck meat products with different herbs elsewhere in North Eastern Region (Hazarika *et al.*, 2014). During festival season particularly during Magh Bihu (Post harvest festival of Assam) there is a tradition of preparing culinary products such as duck meat with ash gourd (*Benincasa hispida*) in Assam which is relished by all sections of the society.

Ash gourd (*Benincasa hispida*) commonly known as winter melon, ash gourd, white pumpkin, wax gourd or Chinese water melon belongs to Cucurbitaceae family and is a native of Japan and Java, however it is cultivated more or less throughout India and other warm countries (Fatariah *et al.*, 2015). Ash gourd is known both for its nutritional and medicinal values among the Asian communities. It is basically cooked by combining with other vegetables, boiled with meat or included in a variety of dishes. Ash gourd (*Benincasa hispida*) is rich in volatile oils, flavonoids, glycosides, saccharides, proteins, carotenes, vitamins, minerals, β - stosterin and uronic acid. It has also therapeutic benefits in gastrointestinal disorders, respiratory diseases, heart diseases, diabetes mellitus and urinary diseases. Traditionally it has been used as a laxative, diuretic, tonic, aphrodisiac, cardiogenic and to prevent urinary calculi , blood disease, insanity, epilepsy, schizophrenia, jaundice, dyspepsia, fever and is also used as antioxidant, anti-inflammatory, analgesic, anti-asthmatic, diuretic, nephroprotective, antidiabetic, hypolipidemic and antimicrobial (Al-Snafi, 2013). The effect of ash gourd (*Benincasa hispida*) on the physico-chemical and storage quality characteristics of duck meat loaves have been well documented (Das *et al.*, 2019).

Keeping in view the benefits of ash gourd and underutilization of duck meat, the present study has been aimed to develop appropriate technology for preparation of duck meat loaves incorporated with ash gourd and study its effect on textural characteristics and colour profile with cost of production

Materials and Methods

Ethical Approval

Ethical approval for slaughtering of ducks was obtained from Institutional Animals Ethics Committee (IAEC), Assam Agricultural University, Khanapara, Guwahati, Assam.

Study Area

The experiment was conducted in the Department of Livestock Products Technology and All India Coordinated Research Project on Post Harvest Engineering Technology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati during the period from June, 2015 to June, 2016.

Materials

Local Pati ducks (*Anas platyrhynchos domesticus*) in age group of 9-12 months irrespective of sex were procured from the Goat Research Station (GRS), Assam Agricultural University, Burnihat. The ducks were slaughtered conventionally in a semi-mechanised poultry dressing unit. The body fat was trimmed off and deboning was done manually by removing all the tendons and separable connective tissue. The deboned meat was packed and stored at -18 ± 2 °C till processing. Spice and condiments viz. (onion, garlic, ginger), dhania (*Coriandrum sativum*), black pepper (*Piper nigrum*), jeera (*Cuminum cyminum*), red chilli powder (*Capsicum frutescens*), kashmiri mirch powder of known brands were purchased from local market. Young and tender ash gourd (*Benincasa hispida*) were purchased fresh from local market washed with clean tap water, peeled off, cut into small pieces and finely minced with the help of a mixer grinder. Ash gourd paste was incorporated at the levels of 5% (Treatment T₁), 7.5% (Treatment T₂) and 10% (Treatment T₃) in the formulation by replacing the lean meat. Several preliminary trials were conducted to optimize the basic formulation and processing conditions for the preparation of duck meat loaves. The formulations used for current study is tabulated below (Table1).

Table1: Different formulation combinations for preparation of duck meat loaf expressed in percentage

Ingredients	Control (C)	T ₁	T ₂	T ₃
Minced duck meat	78	73	70.5	68
Duck fat	10	10	10	10
Ash gourd (<i>Benincasa hispida</i>)	0	5	7.5	10
Spices/condiments	4	4	4	4
Egg white	1.18	1.18	1.18	1.18
Ice cubes	5	5	5	5
Salt	1.5	1.5	1.5	1.5
Sodium nitrite	0.02	0.02	0.02	0.02
Wheat flour	0.3	0.3	0.3	0.3

Preparation of Duck Meat Loaves

The processed duck meat was cut into smaller chunks and grinded in a mincer through 4mm (pore size) plate. Meat emulsion was prepared in bowl chopper (Model: Staddler) by blending with salt, sodium nitrite for 1.5 min, followed by addition of crushed ice and blending was continued for another 1 min. Thereafter, cooked and filtered duck fat in liquid form was added and blended for another 1-2 min. In the final stage, spice mixture, condiments, minced ash gourd (*Benincasa hispida*) at different levels and other necessary ingredients were added as per Table 1 and mixing was continued for 1-2 min to get the desired emulsion. It was followed by stuffing emulsion into a rectangular stainless-steel boxes (mould) and then covered with aluminum foil followed by closing of the lid.

Cooking of Duck Meat Loaves

Preliminary trials were conducted to optimize the temperature and time combination for the preparation of duck meat loaves. The stuffed emulsion mould were cooked in a suitable sauce pan containing water with the mould fully submerged. The loaves were cooked at 85°C for 45 min and the temperature was monitored with a help of a digital thermometer.

Packaging of Cooked Duck Meat Loaves

The moulds after cooking were taken out, cooled down in chilled water and kept overnight at refrigeration temperature (4 ± 1 °C) for chilling. The chilled cooked blocks were sliced manually into suitable rectangular shape of size (L×B×H : 8.6×3.4×1.3cm³) and packaged into food grade polythene bags (HDPE) and evaluated.

Texture Profile Analysis (TPA)

The TPA of the ash gourd incorporated duck meat loaves were performed using TAHD Plus (Stable Micro System,

UK) texture analyzer fitted with a 500kg force load cell. The cubes of loaves samples (LxBxH : 2×1×1cm³) were subject to double-bite compression condition with a spherical test probe (SMS-P/36R) with a test speed of 5mm/sec and data were interpreted in terms of hardness, fracturability, springiness, cohesiveness, chewiness and resilience of the products.

Colour Profile

Colour characteristics of all the duck meat loaves samples was estimated by using spectrophotometer (Cary-100 Bio UV-Vis, M/s Varian, U.S.A.) equipped with solid sample holder and colour software at 200 to 900 nm. L* a* and b* values of duck meat loaves of different combination, respectively, were thus determined.

Cost of Production

The cost of the production was determined by calculating the cost of duck meat, non-meat ingredients (ash gourd, chemicals, spices and condiments) and other lump sum expenses incurred *viz.*, cost of water supply, electricity, labour, processing and packaging cost etc. The expected return/income was calculated according to the existing market rates of the product.

Statistical Analysis

Data obtained in the present study were analysed statistically using one-way ANOVA through SPSS-16.0 software as per standard methods (Snedecor and Cochran, 1994).

Results and Discussion

Texture Profile

The results on the texture profile analysis of duck meat loaves as affected by incorporation of ash gourd (*Benincaa hispida*) at different levels is presented in Table 2. Analysis of variance revealed no significant ($P>0.05$) differences in hardness, fracturability, springiness, cohesiveness, gumminess, chewiness and resilience for both the control and treated groups irrespective of their formulation. The texture profile data revealed almost similar results for all the parameters except for hardness. The results for hardness in control (7.44±2.33) and T₁ (6.23±2.84) groups were numerically higher than T₂ (4.06±1.64) and T₃ (4.52±2.15) groups, however it was found to be non-significant ($P>0.05$) among the different treatment groups. Numerically higher values might be due to low water holding capacity in the control and T₁ groups, respectively (Das *et al.*, 2019). Another reason might be due to high percentage of moisture in *Benincaa hispida* which accounts for approximately 96.0 per cent that might result in softer product in T₃ and T₄ groups. Similar results were observed for sensory evaluation of the products where ash gourd incorporated samples were found to be a bit softer compared to that of the control samples. Kumar *et al.* (2004) reported non-significant differences in the textural characteristics of buffalo meat blocks by incorporation of milk co-precipitate at different levels. However, Hughes *et al.* (1997) reported reduction in gumminess and cohesiveness value, while, other textural parameters were found to be unaffected due to incorporation of different fat levels.

Table 2: Effect of incorporation of ash gourd (*Benincaa hispida*) on texture profile of duck meat loaves*

Treatments	Hardness (Kg/cm ²)	Fracturability (Kg/cm ²)	Springiness (cm)	Cohesiveness (ratio)	Gumminess (Kg/cm ²)	Chewiness (Kg/cm)	Resilience (cm)
Control	7.44±2.33	15.72±5.80	0.2±0.01	0.39±0.09	2.58±0.68	0.53±0.14	0.17±0.08
T ₁	6.23±2.84	17.99±6.33	0.16±0.02	0.34±0.03	1.9±0.84	0.35±0.16	0.14±0.05
T ₂	4.06±1.64	18.4±5.27	0.16±0.008	0.34±0.09	1.11±0.35	0.21±0.07	0.17±0.09
T ₃	4.52±2.15	16.87±4.05	0.15±0.02	0.32±0.06	1.15±0.54	0.2±0.10	0.15±0.08
F value	1.1	1.4	1.27	1.05	1.24	1.28	1.01

n=5; * Mean ± SE; ($P>0.05$)

Colour Profile

Colour is an important criterion used to evaluate food quality and plays an important role in consumers purchasing

decision. Values for colour evaluation of duck meat loaves as affected by incorporation of ash gourd (*Benincasa hispida*) is presented in Table 3. Analysis of variance revealed non-significant ($P>0.05$) differences in the colour profile (L^* = lightness, a^* =Redness and b^* =Yellowness) of duck meat loaves due to incorporation of ash gourd at different levels (5%, 7.5% and 10%). From the values it can be concluded that all the products were dark to dark red tone, thus it could be presumed that ash gourd did not influence the colour profiles of the duck meat loaves. However, Bhosale *et al.* (2011) reported higher values for L^* , a^* and b^* in ground raw carrot and mashed sweet potato incorporated chicken meat nuggets compared to the present findings.

Table 3. Effect of incorporation of ash gourd (*Benincasa hispida*) on colour profile of duck meat loaves*

Treatments	L^*	a^*	b^*
Control	1.93±0.01	0.11±0.02	0.84±0.01
T ₁ (5%AG)	1.95±0.01	0.11±0.02	0.84±0.01
T ₂ (7.5%AG)	1.95±0.01	0.12±0.03	0.82±0.02
T ₃ (10%AG)	1.93±0.01	0.11±0.02	0.82±0.01
F value	1.07	0.51	0.83

$n=5$; * Mean ± SE; ($P>0.05$); AG-Ash gourd

Cost of Production

The cost of production for preparation of duck meat loaves with incorporation of ash gourd (*Benincasa hispida*) is presented in Table 4. From the table it could be observed that highest cost of production was realized in the control group (Rs. 528.00 per Kg) while in the treatment group as the percentage of incorporation of ash gourd increased the cost of production of duck meat loaves decreased and least was observed in T₃ group (Rs. 494.00 per Kg). The decrease in the cost of production in the treatment groups with increase in the level of ash gourd was due to low price of ash gourd compared to duck meat which was used to replace the meat percentage in the formulation. Mendiratta *et al.* (2008) reported that incorporation of seasonal vegetables in emulsion base mutton products reduced the cost of production of value-added meat products like slices, nuggets and patties.

Table 4: Cost of production of duck meat loaves incorporated with ash gourd

Ingredients	Control	T ₁	T ₂	T ₃
Deboned duck meat (Rs 450/Kg)	157.5 (350g)	149.62 (332.5g)	145.68 (323.75g)	141.75 (315g)
Non-meat ingredients(Rs LS)	8.05	8.05	8.05	8.05
Ash gourd (Rs 40/kg)	0	1	1.1	1.2
Processing cost (Rs LS)	60	60	60	60
Total (Rs/427Kg)	225.55	218.67	214.83	211
Total (Rs/Kg)	528.22	511.7	503.11	494.14
Lumpsum (Rs/Kg)	528	512	503	494

Conclusion

Duck meat is a popular non-vegetarian food and is relished immensely by the people of North Eastern Region of India, however, processed duck meat products has not gained much momentum compared to that of chicken products. Processing of duck meat into comminuted value-added meat products may offer better returns to the producers. Duck meat loaves were prepared by incorporation of ash gourd (*Benincasa hispida*) at 5.0, 7.5 and 10.0 per cent, respectively and were subjected to colour and textural profile analysis. The economy of production is also ascertained based on the existing market rate of raw materials and processing cost. Non-significant ($P>0.05$) differences were observed for textural (hardness, fracturability, springiness, cohesiveness, gumminess, chewiness and resilience) and colour profile characteristics of duck meat loaves. Cost of production was found to be the highest in T₁ group (Rs. 512 /kg) and the cost decreased with increased incorporation of ash gourd. Based on the results, it can be concluded that ash gourd (*Benincasa hispida*) can be successfully used for the production of processed ready-to-eat convenient duck meat products with acceptable quality attributes.

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Conflict of Interests

There is no conflict of interest.

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