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# Quality assessment of *Nelumbo nucifera* supplemented functional muscle food

**Bharti SK, Pathak V, Goswami M, Sharma S, Ojha S and Anita**

**Abstract**

Dietary fiber enriched chicken patties were developed by incorporation of fresh lotus stem paste. Four different variants of chicken meat patties with 0, 7.5, 10 and 15% concentrations of fresh lotus stem paste replacing lean meat were formulated followed by optimization of processing conditions. The products were evaluated for different quality parameters viz. raw pH and emulsion stability, cooking yield, dietary fiber, pH, shape index (swell/shrink), proximate, sensory, microbiological and storage analysis. The addition of fresh lotus stem paste significantly ($P<0.05$) increased the pH, cooking yield and emulsion stability as 6.25, 93.04 and 94.73 respectively. There was a significant ($P<0.05$) increase in moisture, dietary fiber and ash content while fat and protein content decreased non-significantly. The sensory scores of patties upto 10% level of fresh lotus stem paste were acceptable. On the basis of physiochemical, proximate and sensory scores, incorporation at 10% was found most suitable which can serve as valuable source for enhancement of fiber in meat products.

**Objective:** Objective of study was to standardize the formulation, processing technology and to evaluate the physico-chemical, microbiological and sensory characteristics along with shelf life study of developed functional chevon patties stored under refrigeration. The study was conducted from March-August 2016.

**Keywords:** Lotus stem, Fiber, Proximate, Chicken patties, Fortification

## 1. Introduction

Meat is an imperative contributor to dietary protein in human diet, and hence has an influential impact on health outcomes [7]. Nutritional richness of meat and meat products are generally acknowledged as an important component of a healthy and well balanced diet. It contains high biological value proteins, fat-soluble vitamins, minerals, trace elements and bioactive compounds [16]. Changes in socio-economic factors during last few decades tremendously augmented the consumption pattern of poultry meat. In comparison with other type of meats, poultry meat is more favorable for processing because of having acceptable flavor, light color, fine consistency and proper texture [29].

In spite of having all the considerable properties meat has some drawbacks as meat is deficient in very essential dietary fiber. Numerous epidemiological studies have associated red, white and processed meat consumption with the development of the many chronic diseases like diabetes, coronary disease and intestinal cancer [2]. Nowadays, the meat quality concept has become more diverse and dynamic which includes eating and technological quality, nutritional value and concern over nutritional diseases of affluence [31]. Moreover, fiber addition in meat products is one of the prime requirements these days, due to its technological use and benefits to human health [35]. Dietary fiber fortified meat products are proclaimed for prevention of diseases like coronary heart disease, diabetes, irritable bowel disease, obesity, regulation of cholesterol and prevention of diabetes and intestinal cancer [27]. Dietary fiber imparts important functional properties to foods like increased water holding capacity, oil holding capacity, emulsification [30], sensory, textural [36] and gel formation. Incorporation of dietary fiber into emulsion alters the rate and extent of lipid digestion. Dietary fiber as a class of compound includes agricultural byproducts of plant carbohydrate polymers like cellulose, hemicelluloses, pectic substances, gums, resistant starch, inulin that may be related with lignin and other non-carbohydrate components (e.g. saponins, phytates, polyphenols, cutin, waxes) [12]. For adults, the recommended acceptable intakes of dietary fiber are 28–36 g/day, 70–80% of which must be insoluble fiber [3]. Lotus (*Nelumbo nucifera*) is an aquatic perennial grows in water and is widely cultivated in Asia [20]. In India, lotus plant reportedly grows in almost all lakes and ponds, both at high (1400 m in the Himalayas, North India) [9] and low altitudes (Kanyakumari, Southern India).

All parts, such as flowers, seeds, leaves, stems, and roots are generally consumed [37]. It contains abundant dietary fiber, vitamins, riboflavin, potassium and copper [8]. Also, it contains antioxidant [28] compounds such as ascorbic acid and phenolic compounds, carotinoids, flavonoids, phenolic acids, and tocopherols. Functionally it is used in medicine as a diuretic, antiemetic, treatment for tissue inflammation, insomnia and cancer [23, 25] reported the use of lotus stem (consists of 6, 2.4, 0.2mg/100g calcium, iron and zinc respectively) as a vegetable used in salads at Vitamin.

Dietary fiber incorporation in meat products appeals to many health conscious consumers looking for low and reduced fat food [38]. Because of its innumerable functional characteristics, dietary fiber can act as a valuable source of extender, binder and fat replacer in the development of various novel meat products. Therefore, the objectives of this study were to investigate the effect of incorporating fresh lotus stem paste, a dietary fiber extract into chicken patties at four different levels on physic-chemical, textural, and sensory properties.

## 2. Materials and Methods

The experiments were conducted in the Department of Livestock Products Technology, College of Veterinary Sciences and Animal Husbandry, U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura, 281001 (UP), India.

### 2.1 Source of material

#### 2.1.1 Chicken meat

The boiler chicken meat was procured from local market, Mathura. The dressed boiler chicken carcasses were removed of separable fat and connective tissues, were hot deboned manually the deboned chicken meat was packed in low density polyethylene bags and stored overnight at 4±1 $^{0}$C in a refrigerator for conditioning.

#### 2.1.2 Spice mix

The ingredients in desired ratio were procured from local market, dried at 45±2$^{o}$C for 2 hours followed by grinding and sieving through 100mesh. The spice mix was stored in low density polyethylene bags and used as per requirement. The formulation contained Anise 10%, Black pepper 5%, Caraway 10%, Cardamom 4%, Chili powder 2%, Cloves 2%, Cinnamon 4%, Cumin 20%, Dry ginger 10%, Fennel 4%, Mace 4%, Turmeric 10% and Coriander 15% (w/w).

#### 2.1.3 Condiments

Condiments used in the study were onion, garlic and ginger in a ratio of 3:2:1 and ground in a mixer to the consistency of fine paste.

#### 2.1.4 Chemicals

All the chemicals used in the study were of analytical grade and procured from Hi Media laboratories (P) Ltd, Mumbai.

#### 2.1.5 Packaging materials

Low density Polyethylene (LDPE) bags were procured from local market Mathura and sterilized by exposing to U.V. light for 30 minutes before use.

#### 2.1.6 Fresh lotus stems paste

Freshly harvested thoroughly cleaned lotus stems were, peeled and cut into small pieces. The pieces of lotus stem were boils in the water for 5 minutes and the excess water was drained out. The boiled lotus stems were ground in a blender to form paste.

### 2.2 Preparation of chicken patties

Deboned chicken chunks are minced in a Sirmen mincer (MOD- TC 32 R10 U.P. INOX, Marsango, Italy) with 6mm plate followed by common grind size, the 4mm plate. The common salt, vegetable oil, refined wheat flour (maida), sodium tripolyphosphate, spice mixture and condiment mix were added to pre-weighed meat according to formulation. Meat emulsion for patties was prepared in Bowl Chopper [MOD C 15 2.8G 4.0 HP, Marsango, Italy]. Minced meat was blended with salt and sodium tripolyphosphate for 1.5 minute. Water in the form of crushed ice was added and blending continued for 1 minute. This was followed by addition of refined vegetable oil and blended for another 1 to 2 minutes. This was followed by addition of spice mixture, condiments and other ingredients and again mixed for 1.5 to 2 minutes to get the desired emulsion. Adequate care was taken to keep the end point temperature below 15 $^{0}$C by preparing the emulsion in cool hours of morning, by addition of meat and other ingredients in chilled/ partially thawed form and by addition of crushed ice or ice water.

**Table 1:** Formulation of chicken patties (%)

| Ingredients | Control | Treatment 1 | Treatment 2 | Treatment 3 |
|---|---|---|---|---|
| Chicken meat | 75 | 67.5 | 65 | 60 |
| Lotus stem paste | 0.0 | 7.5 | 10 | 15 |
| Refined vegetable oil | 05 | 05 | 05 | 05 |
| Ice flakes | 10 | 10 | 10 | 10 |
| Salt | 1.6 | 1.6 | 1.6 | 1.6 |
| Dry spices mix | 2.0 | 2.0 | 2.0 | 2.0 |
| Condiments | 3.0 | 3.0 | 3.0 | 3.0 |
| Refined wheat flour | 3.0 | 3.0 | 3.0 | 3.0 |
| STTP | 0.4 | 0.4 | 0.4 | 0.4 |

#### 2.2.1 Moulding and cooking of patties

About 50 g of emulsion was moulded on steel plate with circular ring (55 mm diameter and 20 mm height). The height and diameter of the patty was determined by Vernier Callipers. Patties were cooked in a pre-heated convection oven at 180°C for 14 minutes after which they were turned and allowed to get cooked for 4 more minutes till internal temperature reached about 75°C (Probe thermometer, Labware Scientific, Inc, USA). The patties were packed in low-density polyethylene pouches and stored at refrigerated temperature (4±1 $^{o}$C).

### 2.3 Analytical procedure

#### 2.3.1 pH

pH was determined by using digital pH meter (WTW, Germany, model pH 330i) by immersing the spear type combination electrode (Sentix®, Germany) directly into minced meat sample.

### 2.3.2 Emulsion stability
The emulsion stability was determined by the method of [6] with minor modifications. Twenty five grams of meat emulsion was taken in polyethylene bag and heated in thermostatically controlled water bath at 80 $^{0}$C for 20 min. after cooling and draining the exudates, the cooked mass was weighed. The percentage of cooked mass was expressed as emulsion stability.

### 2.3.3 Cooking yield
The weight of chicken patties was recorded before and after cooking. The cooking yield was calculated as under and expressed as percentage [24].

$$\text{Cooking yield \%} = \frac{\text{Weight of cooked chicken patties}}{\text{Weight of raw chicken patties}} \times 100$$

### 2.3.4 Dimensional parameters
The dimensional parameters viz. percent gain in height, decrease in diameter and percent shrinkage were measured with the help of vernier caliper and determined according to the standard equations [13].

### 2.3.5 Thiobarbituric Acid Value
TBA value was estimated as per procedure given by [34].

### 2.3.6 Free fatty acid (FFA)
Free fatty acid value was determined by modified AOCS method [21] (Koniecko, 1979).

### 2.4 Proximate composition and dietary fiber content
The moisture, protein, fat and ash content of the chicken patties was determined following standard methods of [5]. Dietary fiber content was analyzed by using [4]

### 2.5 Microbiological analysis
Samples were prepared according to [1]. 1g of sample was transferred to 99ml of normal saline solution and dilutions were prepared. Total plate count, Psycrophilic, Salmonella and yeast & mould count in the samples during storage period were determined.

### 2.6 Sensory parameters
The sensory quality of samples was evaluated by using 8 point descriptive scale [19] where 8 denoted extremely desirable and 1 denoted extremely poor. A sensory panel (semi trained) of seven judges drawn from post-graduate students and staff of Veterinary College, DUVASU, Mathura were requested to evaluate the product for different quality attributes viz., appearance and color, flavor, texture, saltiness, juiciness, mouth coating, meat flavor intensity and overall acceptability.

### 2.7 Statistical analysis
The data obtained in the study on various parameters were statistically analyzed on 'SPSS-16.0' software package as per standard methods of [33]. Duplicate samples were drawn for each parameter and the experiment was replicated thrice (n=6). Sensory evaluation was performed by a panel of seven member judges three times, so total observations being 21 (n=21) Data were subjected to one way analysis of variance, homogeneity test and Duncan's Multiple Range Test (DMRT) for comparing the means to find the effects between samples.

## 3. Results and Discussion
### 3.1 Quality evaluation of freshly prepared fiber enriched chicken patties
### 3.1.1 Physico-chemical properties
There was no significant difference between control and treatments in raw pH values, however pH in cooked patties increased significantly ($P$<0.05) with incorporation of lotus stem paste due to higher pH of lotus stem than meat. There was no significant difference between T1 and T2. The emulsion stability and cooking yield increased significantly ($P$<0.05) with incorporation of lotus stem [18]. Also observed significant ($P$<0.05) increase in emulsion stability of chicken patties with incorporation of lotus stem pulp. There was no significant difference in raw depth and raw width of chicken patties due to maintenance of uniformity in shape and size during preparation, however depth and width of cooked patties showed a significant ($P$<0.05) increase with incorporation of lotus stem pulp due to moisture absorption ability of lotus stem. The cooked depth of T1 was comparable to C as well as T2, whereas there was no significant difference in cooked width between C and T1 as well as T2 and T3.

**Table 2:** Physico-chemical properties of lotus stem incorporated chicken patties

| Parameters | C | T1 | T2 | T3 | Treatment mean |
|---|---|---|---|---|---|
| Raw pH | 5.32±0.01 | 5.36±0.01 | 5.41±0.01 | 5.44±0.04 | 5.38±0.02 |
| Cooked pH | 6.17±0.01$^{c}$ | 6.22±0.01$^{b}$ | 6.24±0.01$^{b}$ | 6.25±0.01$^{a}$ | 6.22±0.01 |
| Emulsion stability | 88.98±0.30$^{d}$ | 91.25±0.44$^{c}$ | 93.39±0.28$^{b}$ | 94.73±0.15$^{a}$ | 92.09±0.47 |
| Coking yield | 86.61±0.35$^{c}$ | 88.54±0.21$^{b}$ | 90.33±0.71$^{b}$ | 93.04±0.42$^{a}$ | 89.63±0.53 |
| Raw depth | 1.25±0.03 | 1.25±0.03 | 1.21±0.01 | 1.23±0.02 | 1.23±0.01 |
| Raw width | 6.28±0.09 | 6.33±0.16 | 6.48±0.10 | 6.51±0.08 | 6.40±0.02 |
| Cook depth | 1.33±0.03$^{c}$ | 1.53±0.06$^{bc}$ | 1.61±0.07$^{b}$ | 1.96±0.04$^{a}$ | 1.61±0.05 |
| Cook width | 5.88±0.04$^{b}$ | 5.90±0.06$^{b}$ | 6.19±0.02$^{a}$ | 6.26±0.04$^{a}$ | 6.04±0.04 |

Mean±SE with different superscripts in a row differ significantly ($P$<0.05)

### 3.1.2 Proximate analysis
The moisture content increased significantly ($P$<0.05) in lotus stem paste incorporated chicken patties, however there was no significant difference between C and T1. The higher moisture percent in lotus stem paste incorporated patties might be due to water absorption capacity of lotus stem fiber. Similar results were reported by [8] who observed increased moisture content on addition of lotus leaf powder indicating that the added fiber in lotus stem powder and barley powder resulted in retention of moisture. The protein and fat content decreased significantly ($P$<0.05) in treatments than control. The ash content of control was significantly ($P$<0.05) lower than natural fiber incorporated chicken patties, however there was no significant difference in between treatments for ash content [8]. reported that reduced-fat pork patties containing *Laminaria japonica* had significantly higher moisture and ash contents than control patties while protein content and fat content of control samples with regular-fat level are higher than reduced-fat pork patties containing *Laminaria japonica.*

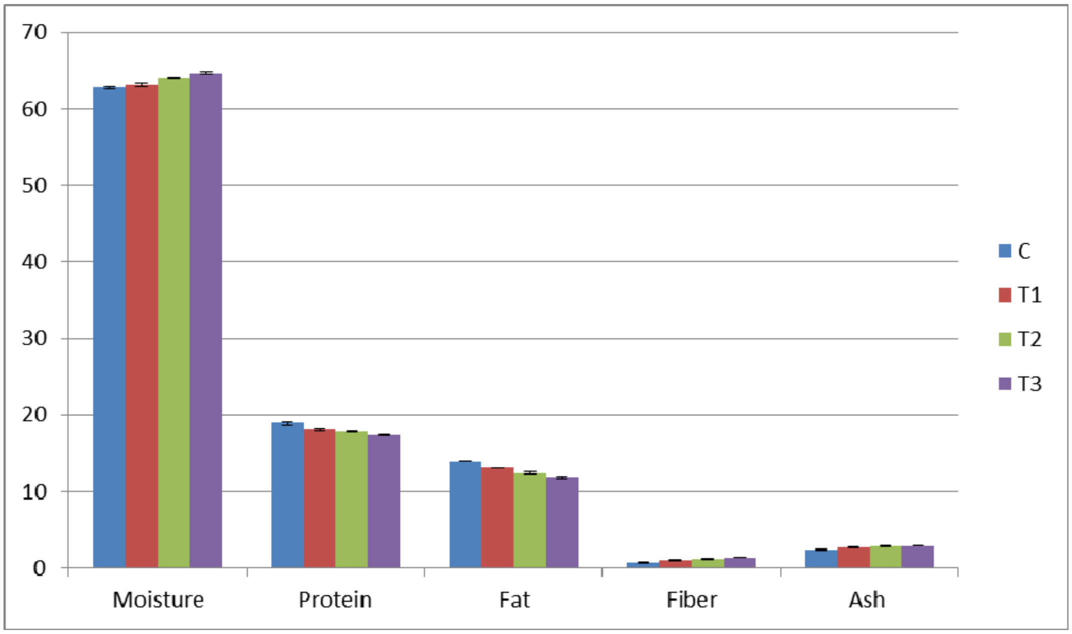


**Fig 1:** Proximate analysis of lotus stem incorporated chicken patties

### 3.1.3 Sensory evaluation

All sensory attributes showed significant ($P<0.05$) difference between control and treatments except texture and saltiness scores. Color and appearance scores decreased significantly ($P<0.05$) with lotus stem paste incorporation, however there was no significant difference between T1 and T2. Flavor and mouth coating scores had no significant difference upto 10% level, but decreased significantly ($P<0.05$) at 15% level of lotus stem paste in chicken patties. Juiciness scores were significantly ($P<0.05$) higher in treatments than control which might be due to moisture retention capacity of lotus stem, however there was no significant difference among the treatments. Overall acceptability scores showed no significant difference upto 10% level, but decreased significantly ($P<0.05$) at 15% level of lotus stem paste incorporation. Therefore, T2- fiber enriched chicken patties incorporated with 10% lotus stem paste were selected as the best treatment and compared with control for storage stability till spoilage.

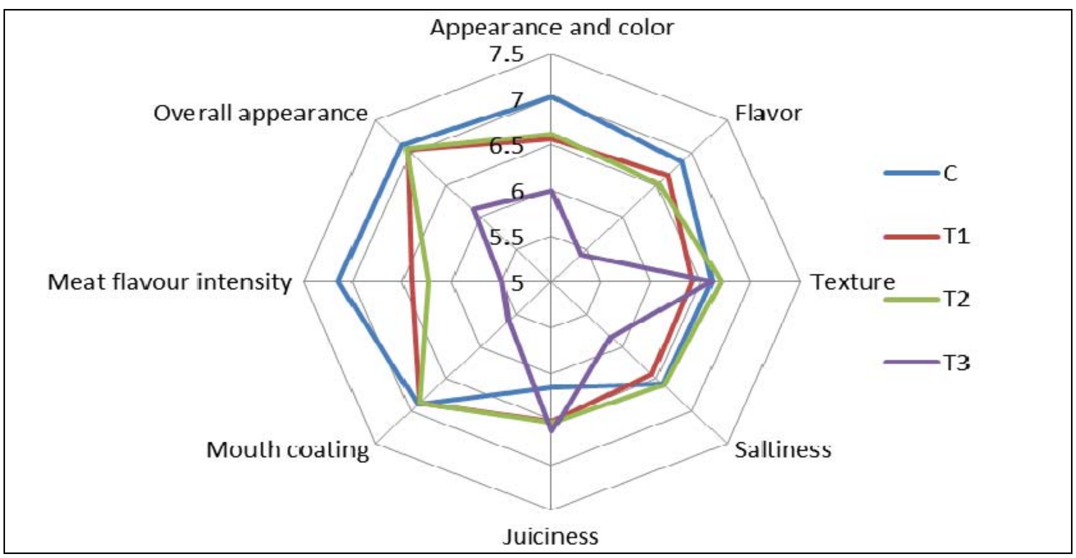


**Fig 2:** Sensory evaluation of lotus stem incorporated chicken patties

### 3.2 Storage stability evaluation of fiber enriched chicken patties

### 3.2.1 Physico-chemical properties

TBARS value is a measure of secondary lipid oxidation products in meat [26]. An increase in TBARS value is an indicator of the development of oxidative rancidity, however FFA content is a measure of hydrolytic rancidity in meat products determining the quality of product and expressed as % oleic acid. TBA and FFA values increased significantly ($P<0.05$) with progression of storage period. [11, 32] also observed significant ($P<0.05$) increase in TBARS values in natural fibers incorporated meat loaves and sausages respectively during storage under refrigeration. There was no significant difference between C and T2 during whole storage period for TBA values however FFA value showed significant ($P<0.05$) difference on 16th day of storage. The lower FFA value of T2 than C might be due to presence of phenolic compounds and flavinoids in lotus stem [14, 15] also observed antioxidant properties in lotus rhizome and leaf ethanolic extract.

Total plate count increased significantly ($P<0.05$) with progression of storage period in C as well as T2, however there was no significant ($P>0.05$) difference between C and T2 at any day of storage. There was no Psychrophilic growth on 0 day in C and T2, was observed from 4th day till end, which increased significantly ($P<0.05$) at each day interval of storage. There was no significant difference between C and T2 during whole storage period except on 4th and 16th day. Yeast and mould count was not observed in chicken patties upto 4th day, however detected 8th day onwards in both C as well as T2. In present study, *Salmonella* counts were not detected on any day of storage period. The absence of these groups of bacteria during storage might be attributed to high processing temperature and hygienic handling and packaging of product.

The Yeast and mould count of T2 was significantly ($P<0.05$) lower than C on 12 and 16th day of storage. The lower microbial count in lotus stem paste incorporated chicken patties than control might be due to antimicrobial and antioxidant properties of lotus stem. Similar findings were also observed by [18] in lotus stem extract incorporated chicken patties [17]. also exhibited moderate antibacterial activity of aqueous extract of lotus stem against *S. aureus* and *C. Albicans.*

**Table 3:** Physico-chemical properties and microbiological studies of lotus stem incorporated chicken patties under refrigeration storage at 4±1 $^0$C

| | 0 day | 4 day | 8 day | 12 day | 16 day | Storage mean |
|---|---|---|---|---|---|---|
| **TBARS** | | | | | | |
| C | 0.11±0.01$^e$ | 0.24±0.01$^d$ | 0.46±0.02$^c$ | 0.76±0.01$^b$ | 1.08±0.04$^a$ | 0.53±0.06 |
| T2 | 0.11±0.01$^d$ | 0.18±0.01$^d$ | 0.38±0.03$^c$ | 0.64±0.01$^b$ | 1.02±0.04$^a$ | 0.47±0.06 |
| **FFA** | | | | | | |
| C | 0.46±0.01$^e$ | 0.55±0.01$^d$ | 0.63±0.02$^c$ | 0.83±0.01$^b$ | 1.13±0.02$^{aB}$ | 0.72±0.04 |
| T2 | 0.39±0.01$^d$ | 0.41±0.01$^d$ | 0.54±0.01$^c$ | 0.72±0.02$^b$ | 0.90±0.01$^{aB}$ | 0.20±0.03 |
| **Total Plate Count** | | | | | | |
| C | 2.59±0.02$^e$ | 3.74±0.07$^d$ | 4.68±0.05$^c$ | 5.74±0.03$^b$ | 6.41±0.07$^a$ | 4.63±0.25 |
| T2 | 1.71±0.03$^e$ | 2.89±0.02$^d$ | 3.88±0.02$^c$ | 4.66±0.04$^b$ | 5.60±0.08$^a$ | 3.75±0.25 |
| **Psychrophilic count** | | | | | | |
| C | ND | 1.26±0.15$^{dA}$ | 2.73±0.02$^c$ | 3.88±0.10$^b$ | 4.44±0.10$^{aA}$ | 2.46±0.30 |
| T2 | ND | 0.85±0.10$^{dB}$ | 1.41±0.20$^c$ | 2.73±0.24$^b$ | 3.85±0.17$^{aB}$ | 1.77±0.25 |
| ***Salmonella* count** | | | | | | |
| C | ND | ND | ND | ND | ND | ND |
| T2 | ND | ND | ND | ND | ND | ND |
| **Yeast and Mould count** | | | | | | |
| C | ND | ND | 1.16±0.01$^c$ | 1.32±0.10$^{bA}$ | 1.40±0.20$^{aA}$ | 0.77±0.11 |
| T2 | ND | ND | 1.02±0.15$^c$ | 1.13±0.01$^{bB}$ | 1.26±0.02$^{aB}$ | 0.68±0.10 |

Mean±SE with different superscripts in a row differ significantly ($P<0.05$)

### 3.2.2 Sensory evaluation

The sensory attributes of stored chicken patties incorporated with 10% lotus stem paste (T2) were compared with control (C) for appearance and color, flavor, texture, saltiness, juiciness, mouth feel, meat flavor intensity and overall acceptability. The sensory scores for all attributes decreased significantly ($P<0.05$) in C as well as T2 with progression of storage period. This decrease in appearance and color score might be due to some pigment and lipid oxidation resulting in non-enzymatic browning as well as surface dehydration in aerobic packaging [22]. The reason for decrease in flavor scores might be increase in lipid oxidation, protein degradation and some bland flavor due to fat degradation. Lower juiciness, mouth feel and meat flavor intensity scores of chicken patties under refrigeration storage might be because of moisture absorption by LDPE under aerobic packaging [10, 22]. Also observed decreased overall acceptability scores of aerobically packaged low fat goat meat nuggets and chicken patties stored under refrigeration and frozen storage respectively. On comparison of C and T2 on every 4 day interval of storage, appearance and color scores were significantly ($P<0.05$) higher in C than T2 on 4and 8th day, but no significant difference was observed on 0, 12 and 16th day. Flavor scores of C were significantly ($P<0.05$) higher than T2 upto 8th day, however T2 had significantly ($P<0.05$) higher flavor scores than C on 12 and 16th day of storage, which might be due to antioxidant and antimicrobial properties of lotus stem delaying the spoilage and lipid oxidation of product. The texture scores of T2 were significantly ($P<0.05$) higher than C upto 12th day, but no significant difference was observed on 16th day. There was no significant difference between C and T2 for saltiness, mouth feel and meat flavor intensity scores throughout the storage study. Juiciness scores of T2 were significantly ($P<0.05$) higher than C upto 8th day, however there was no significant difference observed on further storage of chicken patties. The overall acceptability scores of C were significantly ($P<0.05$) higher than T2 on 0 and 4th day, there was no significant difference on 8th day, whereas opposite trend was observed on 12 and 16th day, where OA scores of T2 were significantly ($P<0.05$) higher than C. The possible reason behind this might be the presence of flavinoids and phenolic compounds in lotus stem providing it flavor as well as antioxidant and antimicrobial activity.

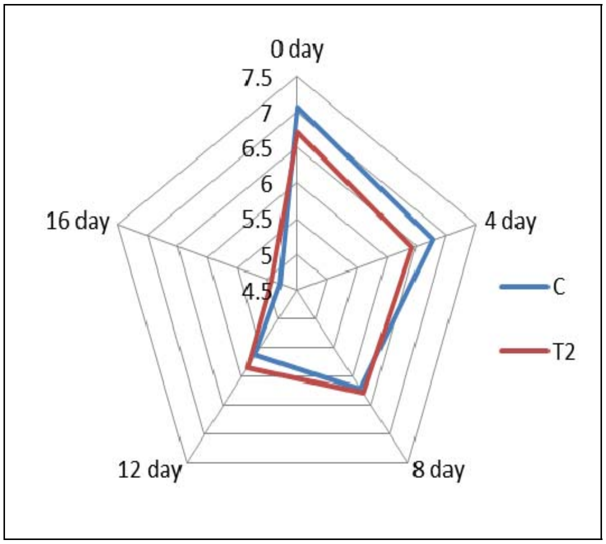


**Fig 3:** Apperance and color score under refrigeration storage at 4±1 $^{0}$C

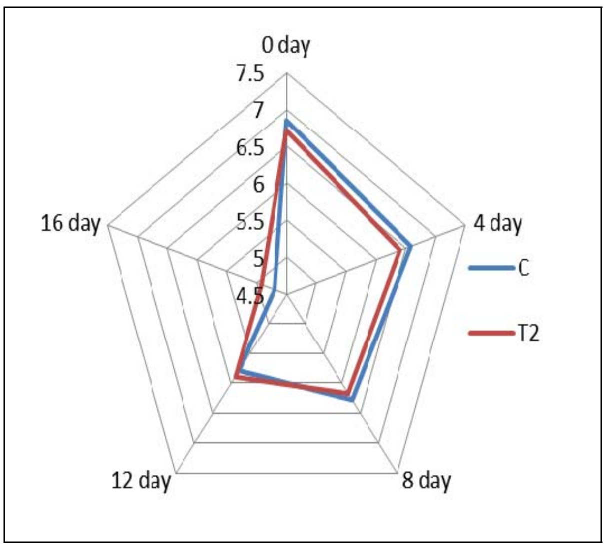


**Fig 4:** Flavor score under refrigeration storage at 4±1 $^{0}$C

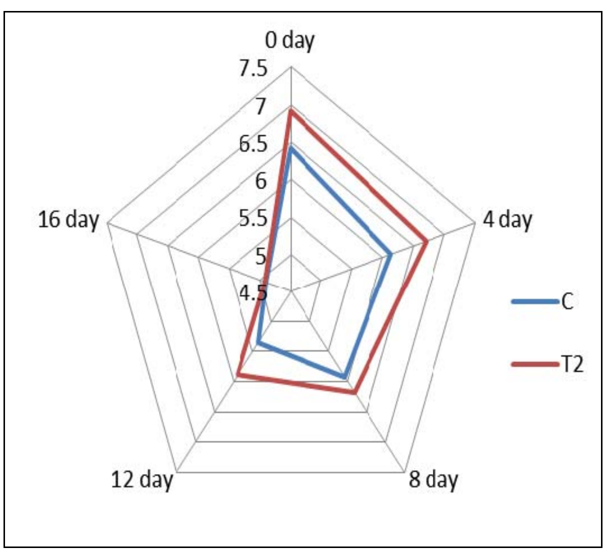


**Fig 5:** Texture score under refrigeration storage at 4±1 $^{0}$C

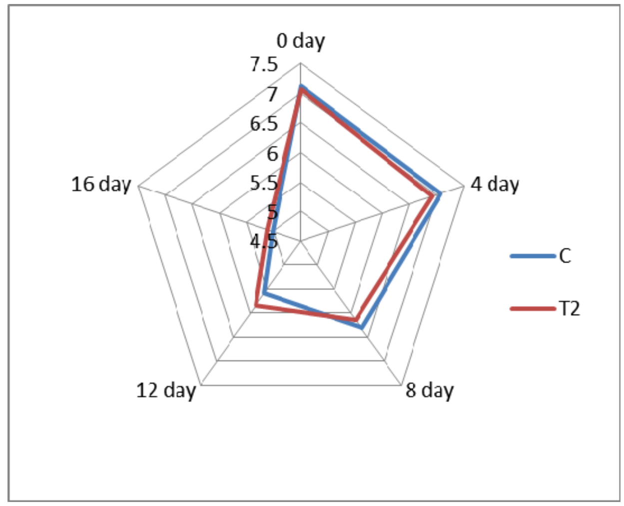


**Fig 6:** Overall acceptability score under refrigeration storage at 4±1 $^{0}$C

## 4. Conclusion

Fortification of lotus stem paste, yielded products with complemented physico-chemical and sensory quality attributes. The meat patties containing lotus stem paste had superior cooking yield and shrinkage during cooking. Moreover addition of higher percentages of lotus stem paste resulted in products with lower sensory scores. The incorporation of dietary fiber into meat product might result in supplementary nutritional surge for the consumer. These findings can be helpful in improving product quality, so as to achieve a product with more healthier and nutritional content.

## 5. References


1. Abete I, Romaguera D, Vieira AR, Adolfo Lopez de M, Norat T. Association between total, processed, red and white meat consumption and all-cause, CVD and IHD mortality: a meta-analysis of cohort studies. British Journal of Nutrition. 2014; 112:762-775.
2. Anderson JW, Baird P, Davis RH, Ferreri S, Knudtson M, Koraym A *et al*. Health benefits of dietary fiber. Nutrition reviews. 2009; 67(4):188-205.
3. AOAC. Association of Official Analytical Chemists, Official Methods of Analysis. 17th edn. Washington, D.C, 1995.
4. AOAC. Association of Official Analytical Chemists. Official methods of analysis. 2005; 18th ed. Arlington.
5. APHA. Compendium of Methods for the Microbiological Examination of Foods, 2nd edn. Washington, DC: American Public Health Association, 1992, 5-99.
6. Baliga BR, Madaiah N. Quality of sausage emulsion prepared from mutton. Journal of Food Science. 1970; 35:383-385.
7. Carrizo D, Chevallier OP, Woodside JV, Brennan SF, Cantwell MM, Cuskelly G *et al* Untargeted metabolomic analysis of human serum samples associated with different levels of red meat consumption: A possible indicator of type 2 diabetes? Food Chemistry. 2017; 221:214-221.
8. Choe JH, Jang A, Lee ES, Choi JH, Choi YS, Han DJ*et al*. Oxidative and color stability of cooked ground pork containing lotus leaf (*Nelumbo nucifera*) and barley leaf (Hordeum vulgare) powder during refrigerated storage. Meat science. 2011; 87(1):12-18.

9. Choi HY, Jung KH, Shin HS. Antioxidant activity of the various extracts from different parts of lotus (*Nelumbo nucifera* Gaertner). Food Science Biotechnology. 2009; 81:1051-1054.
10. Das AK, Anjaneyulu, ASR, Verma AK, Kondaiah N. Effect of full-fat soy paste and soy granules on quality of goat meat patties. Internation Journal of Food Science and Technology. 2008; 43:383-392.
11. Devatkal S, Mendiratta SK, Kondaiah N. Quality characteristics of loaves from buffalo meat, liver and vegetables. Meat Science. 2004; 67(3):377-383.
12. Elleuch M, Bedigian D, Roiseux O, Besbes S, Blecker C, Attia H. Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. Food chemistry. 2011; 124(2):411-421.
13. El-Magoli SB, Laroria S, Hansen PMT. Flavor and texture characteristics of low-fat ground beef patties formulated with whey protein concentrate. Meat Science. 1996; 42:179-193.
14. Gnana JA, Estherlydia D. Phytochemical screening and antioxidant activity of lotus (*Nelumbo nucifera*) stem. International Journal of Pharma and Bio Sciences. 2014; 5(4):(B)385-393.
15. Huang B, Ban XQ, He JS, Tong J, Tian J, Wang YW. Hepato-protective and antioxidant activity of ethanolic extracts of edible lotus (*Nelumbo nucifera* Gaertn.) leaves. Food Chemistry. 2010; 120(3):873-878.
16. Jimenez-Colmenero F, Carballo J, Cofrades S. Healthier meat and meat products: Their role as functional foods Meat Science. 2001; 59(1):5-13.
17. Jyoti DV, Padma S. Biochemical, organoleptic and anti-microbial assessment of lotus stem (*Nelumbo nucifera*). International Journal of Food and Nutritional Sciences. 2015; 4(3):63-69.
18. Kaur M, Kumar A, Bhardwaj D, Bhat AA. Proximate, sensory and storage quality attributes of lotus (Nymphaea nelumbo) stem pulp fortified designer chicken patties. Journal of Food, Agriculture and Environment. 2016; 14 (2):49-53.
19. Keeton JT. Effect of fat and sodium chloride phosphate levels on the chemical and sensory properties of pork patties. Journal of Food Science. 1983; 48:878-881.
20. Kim GS, Park GS. Quality characteristics of cookies prepared with lotus leaf powder. Korean journal of food and cookery science. 2008; 24(3):398-404.
21. Koniecko R. Handbook of meat Chemists. A very Publishing Group, Inc. Wayne, New Jersy. 1979; 53-55.
22. Mehta N, Sharma BD, Kumar P, Kulkarni DC. Storage quality attributes of aerobically packaged low fat chicken patties fortified with Calcium, Alpha tocopherol and Ascorbic acid at refrigeration temperature (4±1°C). Indian Journal of Poultry Science. 2014; 49(3):269-273.
23. Mukherjee PK, Mukherjee D, Maji AK, Rai S, Heinrich M. The sacred lotus (*Nelumbo nucifera*)–phytochemical and therapeutic profile. Journal of Pharmacy and Pharmacology. 2009; 61(4):407-422.
24. Murphy EW, Criner PE, Grey BC. Comparison of methods for calculating retention of nutrients in cooked foods. Journal of Agriculture and Food Chemistry. 1975; 23:1153-1157.
25. Ogle BM, Dao HTA, Mulokozi G, Hambraeus L. Micronutrient composition and nutritional importance of gathered vegetables in Vietnam. International Journal of Food Science and Nutrition. 2001; 52:485-499.
26. Olsen E, Vogt G, Veberg A, Ekebery D, Nilsson A. Analysis of early lipid oxidation in smoked comminuted pork sausages with spices. Journal of Agriculture and Food Chemistry. 2005; 53:7448-7457.
27. Özvural EB, Vural H, Gökbulut İ, Özboy-Özbaş Ö. Utilization of brewer's spent grain in the production of Frankfurters. International Journal of Food Science and Technology. 2009; 44(6):1093-1099.
28. Park CH, Hur JM, Song KS, Park JC. Phenolic compounds from the leaves of *Nelumbo nucifera* showing DPPH radical scavenging effect. Korean Journal of Pharmacognosy. 2007; 38:263-269
29. Petracci M, Bianchi M, Mudalal S, Cavani C. Functional ingredients for poultry meat products. Trends in Food Science and Technology. 2013; 33(1):27-39.
30. Qin D, Yang X, Gao S, Yao J, McClements DJ. Influence of Hydrocolloids (Dietary Fibers) on Lipid Digestion of Protein-Stabilized Emulsions: Comparison of Neutral, Anionic, and Cationic Polysaccharides. Journal of Food Science. 2016; 81(7):C1636-C1645.
31. Razmaitė V, Šveistienė R, Švirmickas GJ. Compositional characteristics and nutritional quality of Eurasian beaver (Castor fiber) meat. Czech Journal of Food Science. 2011; 29(5):480-486.
32. Revilla I, Quintana AMV. The effect of different paprika types on the ripening process and quality of dry sausages. International Journal of Food Science and Technology. 2005; 40(4):411-417.
33. Snedecor GW, Cochran WG. Statistical Methods, 8th edn. New Delhi: Oxford and IBH Publishing Company 1995.
34. Tarladgis BG, Watts BM, Younathan MT, Dugan LR. A distillation method for the quantitative determination of malonaldehyde in rancid foods. Journal of American Oil Chemistry Society. 1960; 37:44-48.
35. Vendrell-Pascuas S, Castellote-Bargallo AI, Lopez-Sabater MC. Determination of insulin in meat products by high performance liquid chromatography with refractive index detection. Joural of Chromatographical Analysis. 2011; 881:591-597.
36. Waszkowiak K, Szymandera-Buszka K. The application of wheat fibre and soy isolate impregnated with iodine salts to fortify processed meats. Meat Science. 2008; 80:1340-1344.
37. Yoon SJ, Noh KS. The effect of lotus leaf powder on the quality of Dasik. Korean Journal of Food and Cookery Science. 2009; 25(1):25-30.
38. Zhuang X, Han M, Kang ZL, Wang K, Bai Y, Xu XL *et al*. Effects of the sugarcane dietary fiber and pre-emulsified sesame oil on low-fat meat batter physicochemical property, texture, and microstructure. Meat science. 2016; 113:107-115.