PHYSICO-CHEMICAL AND ECONOMIC EVALUATION OF BROILER BREAST FILLETS
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Abstract: Broiler breeder breast fillets are tough and less tender and available at lower price in market as compared to broiler meat. They can be sold on a higher demand with premier price by different processing. On the basis of physico-chemical parameters and sensory evaluations cooking time were standardized for broiler breast fillets preparation. Standardized cooking method reported in this study were 50 min. for hot air oven cooking, 40 min. for microwave grilling cooking, 10 min. for microwave cooking and steam cooking 40 min plus shallow frying 5 min. Microwave grilling cooking method reported best for broiler breast fillets preparation on the basis of physico-chemical parameters and sensory evaluations.

Keywords: breast fillets, physico-chemical parameters, sensory evaluations, cooking time.

Introduction
Broiler breeder breast fillets are tough and less tender and available at lower price in market as compared to broiler meat. Their product preparation in form of fillets will fetch premier price in the market. The development of broiler breeder breast fillets in the laboratory will be only successful when this product runs into the market. But the economics and nutritive value are the important criteria which determine the acceptability and marketability of any edible product. For this, economics of breast fillets production on pilot scale is worked out to evaluate the feasibility and viability of production with a view to transferring the technology to small entrepreneurs. Cost economics has been calculated for economical production of breast fillet including distributers and other beneficiaries. On the basis of physico-chemical parameters and sensory evaluations cooking time were standardized for broiler breast fillets preparation.

Materials and methods

Sample collection
Breast muscle samples (Broiler Breeder, above 50 wks of age) were collected from Experimental Poultry Processing Plant of ICAR-Central Avian Research Institute, Izatnagar, Bareilly.

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**Preparation of marinade**

Several preliminary trials were conducted to standardize marinade and this standardized marinade was used for marination of breast fillets. The marinade formulation contained water (10%), ground mustard seed, spice mixture, salt, black pepper, condiment, vegetable oil, tomato sauce and other seasoning (90%). Marination time was kept 45 minutes for all cooking methods.

The pH of breast fillets were determined a Bench top digital pH meter equipped with a glass electrode and automatic temperature sensors.

**Selection of best cooking method**

In this research four cooking methods were optimized (viz., hot air oven, microwave grilling, direct microwave power cooking and steam plus shallow frying) and these cooking methods were compared and the best cooking method was selected, in which, methodology for preparation of marinade, marination time and cooking schedule kept similar. The experiment was replicated thrice and the products were evaluated for different parameters such as pH, moisture %, cooking yield and sensory evaluation. On the basis of physico-chemical parameters and sensory evaluations cooking time was standardized first for individual cooking method (hot air oven cooking 50 min, microwave grilling cooking 40 min, microwave cooking 10 min and steam cooking 40 min plus shallow frying 5 min), and after standardizing cooking time for each cooking method. All 4 cooking methods were compared simultaneously on the basis of physico-chemical parameters and sensory evaluations to select the best cooking method.

**Statistical Analysis**

Experimental data were analysed statistically using standard software package as mentioned by Snedecor and Chochran. Physio-chemical analysis was evaluated using one-way ANOVA.

**Results and Discussion**

**Physico-chemical parameters**

Physico-chemical parameters among four different cooking methods were compared in Table 1. Hot air oven cooking (T1), Grilling in microwave (T2), Microwave cooking (T3), Steaming + Shallow frying (T4) cooking methods were used in this study.

Highest pH value was recorded in T2 and T4 and lowest value in T3. This may be because cooking methods exert significant effect on moisture percent and for this T1, T2, T3 and T4 differed significantly. Highest moisture content (52.47%) was found in T2 cooking. Among
all cooking methods, cooking yield percent was highest in T2 (82.74%) and lowest in T3 (55.18%).

Singh et al. (2015) reported significantly (P<0.05) lower moisture percent for hot air oven cooking than other cooking methods (deep fat fry, air fry and hot air oven plus shallow frying). Similar findings have been reported by Verma et al. (2013) but Salama (1993) and Hoda et al. (2002) observed that microwave oven cooked meat products had lower moisture content than conventional oven cooking. Our results also showed lower moisture percent in hot air cooking and lowest in microwave. Sharma et al. (2005) reported that microwave unpacked cooked chicken meat patties had lower moisture, less juiciness and harder texture than LDPE packed oven cooked patties. These results are in agreement with our findings where microwave cooking shows significantly lowest moisture content, harder texture and lowest cooking yield amongst all four cooking methods. This is because in microwave cooking rapidly increase temperature of water to boiling point so moisture loss is more and it oozes out from breast fillets during microwave cooking.

### Sensory parameters

Sensory attributes among four different cooking methods were compared in Table 1. Hot air oven cooking (T1), Grilling in microwave (T2), Microwave cooking (T3), Steaming + Shallow frying (T4) cooking methods were used in this study.

Sensory attributes consists of color and appearance, texture, flavor, juiciness and overall acceptability. While comparing all sensory parameters amongst four different cooking techniques T2 and T3 samples showed highest and lowest values respectively. On the basis of overall acceptability score order of these four cooking methods is T2>T1>T4>T3. Overall acceptability was found 6.67, 7.75, 5.67 and 6.42 for T1, T2, T3 and T4 cooking methods, respectively. So, on the basis of sensory evaluation it was found that T2 (MW grilling) cooking method showed better results. But contradictory results were reported by Nisar et al. (2010), where buffalo patties scored significantly (p<0.05) higher score for texture of hot air oven cooked than in microwave and pressure cooked. Sharma et al. (2005) also reported that chicken meat patties cooked by microwave oven were hard and had lower juiciness scores and other sensory characteristics than convection oven cooked patties. Pawar et al. (2002) reported that the aroma, flavour and palatability of hot air oven cooked meat products were found to be better and more acceptable as compared to microwave oven cooked products. In this study breast fillets cooked by microwave grilling were rated best followed by hot air oven cooking and lastly microwave cooking.
Nisar et al. (2010) found the hot air oven cooked patties were rated the best in terms of overall acceptability of the product, similar findings were observed by Raj et al. (2005), Hoda et al. (2002) and Pawar et al. (2000). Similar finding was in our study except in microwave grilling cooking method. So in this study microwave grilling cooking was found best, then hot air oven, then steam plus shallow fry and finally microwave cooking for overall acceptability score of breast fillets.

**Table 1: Effect of different cooking methods on physico-chemical and sensory quality of broiler breast fillets (Mean±SE)**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T₁</td>
</tr>
<tr>
<td><strong>Physicochemical quality</strong></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>5.75 ± 0.002ᵇ</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>53.85 ± 0.05ᶜ</td>
</tr>
<tr>
<td>Cooking yield (%)*</td>
<td>76.03 ± 0.08ᵃ</td>
</tr>
<tr>
<td><strong>Sensory evaluation</strong></td>
<td></td>
</tr>
<tr>
<td>Appearance &amp; colour</td>
<td>6.83 ± 0.13ᵇᵃ</td>
</tr>
<tr>
<td>Texture</td>
<td>7.00 ± 0.001ᵇᶜ</td>
</tr>
<tr>
<td>Flavour</td>
<td>6.58 ± 0.13ᵃ</td>
</tr>
<tr>
<td>Juiciness</td>
<td>6.67 ± 0.14ᵃ</td>
</tr>
<tr>
<td>Overall acceptability</td>
<td>6.67 ± 0.09ᵇ</td>
</tr>
</tbody>
</table>

n=6; *n=3; **n=12# Based on 8-point descriptive scale (where 8=extremely desirable and 1=extremely undesirable). Mean±S.E. with different superscript row-wise (small letter) differ significantly (P < 0.05). T₁= Hot air oven cooking (50 min), T₂=Grilling in microwave (40 min.), T₃=Microwave cooking (11 min), T₄=Steaming (40 min) + Shallow frying (5 min)

**Cost economics for pilot scale production**

The economics was therefore, worked out with the following assumptions-

1. Per day production of breast fillets in a unit is 25 kg (100 packets of breast fillets each of 250 grams).

2. The unit/plant remains in production for a total of 25 days in a month. Therefore the monthly production target of breast fillets is 25 x 100 packets = 2500 fillets packets of 250 g each, in a month (average 82% cooking yield after cooking, so to get 25 kg cooked fillets per day it requires to take 30 kg breast fillets for cooking per day).
3. The cost of all ingredients is calculated on the basis of prevalent rates in the local market.
4. To estimate an accurate cost of the production of the breast fillets under commercial conditions, the expenditure incurred in terms of recurring and non-recurring items, labour charges, water and electricity charges, depreciations on machineries, rent paid, capital investment and its interest had taken into consideration.
5. Receipt is only from the sale of breast fillets and not from the byproducts.
6. Disposal of finished product is cent per cent and handling and other losses are nil.
7. The interest rate on principal investment, borrowed capital etc. are in accordance with the rate of NABARD or Farmers Co-operative Banks between 12-13\% per annum.

### Formulation cost of 30 kg broiler breeder breast fillets

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Rate (Rs./kg)</th>
<th>Quantity (kg)</th>
<th>Cost (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broiler breeder breast fillets</td>
<td>170.00</td>
<td>30</td>
<td>5100.00</td>
</tr>
<tr>
<td>Ground mustard seed</td>
<td>100.00</td>
<td>0.9</td>
<td>90.00</td>
</tr>
<tr>
<td>Spice mixture</td>
<td>300.00</td>
<td>0.6</td>
<td>180.00</td>
</tr>
<tr>
<td>Table salt</td>
<td>18.00</td>
<td>0.6</td>
<td>11.00</td>
</tr>
<tr>
<td>Black pepper powder</td>
<td>1200.00</td>
<td>75 g</td>
<td>90.00</td>
</tr>
<tr>
<td>Condiments</td>
<td>60.00</td>
<td>1.5</td>
<td>90.00</td>
</tr>
<tr>
<td>Mustard oil</td>
<td>110.00</td>
<td>1.5</td>
<td>165.00</td>
</tr>
<tr>
<td>Tomato sauce</td>
<td>130.00</td>
<td>1.5</td>
<td>195.00</td>
</tr>
<tr>
<td>Water</td>
<td>2.00</td>
<td>3</td>
<td>6.00</td>
</tr>
<tr>
<td>Citric acid</td>
<td>504.00</td>
<td>45 g</td>
<td>23.00</td>
</tr>
<tr>
<td>Sodiumtri-polyphosphate</td>
<td>360.00</td>
<td>90 g</td>
<td>32.00</td>
</tr>
<tr>
<td>Sodium ascorbate</td>
<td>2520.00</td>
<td>1.5 g</td>
<td>4.00</td>
</tr>
<tr>
<td>Sodium nitrite</td>
<td>504.00</td>
<td>0.75 g</td>
<td>0.50</td>
</tr>
</tbody>
</table>

**Total** = Rs. 5986.00
Processing equipment cost:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Equipments</th>
<th>Unit cost</th>
<th>Approx. cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grill machine</td>
<td>70,000</td>
<td>70,000</td>
</tr>
<tr>
<td>2</td>
<td>Stainless steel table</td>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td>3</td>
<td>Digital weighing balance</td>
<td>18,000</td>
<td>18,000</td>
</tr>
<tr>
<td>4</td>
<td>Impulse sealer</td>
<td>5,000</td>
<td>5,000</td>
</tr>
</tbody>
</table>

Total = Rs. 1,13,000

Storage equipments (for meat):

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Equipment</th>
<th>Unit cost</th>
<th>Approx. cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Deep freezer (345 lit.)</td>
<td>150,000</td>
<td>150,000</td>
</tr>
<tr>
<td>2</td>
<td>Refrigerator (500 lit.)</td>
<td>60,000</td>
<td>60,000</td>
</tr>
<tr>
<td>3</td>
<td>Three wheeler (Van Rickshaw)</td>
<td>15,000</td>
<td>15,000</td>
</tr>
<tr>
<td>4</td>
<td>Containers, knives</td>
<td>-</td>
<td>50,000</td>
</tr>
</tbody>
</table>

Total = Rs. 2,25,000/-

Total cost of equipments = Rs. 3,38,000/-

Equipments depreciation @ 10% per annum = Rs.33,800.00 /-

Per day basis = Rs. 113.00/- (300 working days)

Labour charges:

- Skilled worker (two) = Rs. 500.00 per day
- Unskilled worker (two) = Rs. 300.00 per day
- Electricity charges (approx 30 KWH per day) = Rs. 230/-
- Cost of packaging (polyethylene bags) 150 x 1 = Rs. 150/-
- Water charges (1000 lit.) = Rs. 50/- per day
- Building (rent) = Rs. 12000/- per month
- @ Rs. 300 per day

Miscellaneous = Rs. 150/- per day (cleaning agents, knife sharpening etc.)

Total = Rs. 1680.00 per day
Total overhead charges = Rs. 113.00 + Rs. 1680.00 = Rs.1793.00
Total processing cost for preparation (30 kg) of breast fillets = overhead charges +
formulation cost = Rs. 1793.00 + Rs. 5986.00 = Rs. 7779.00 say Rs. 7780/-
Final finished product yield of 80 % of the formulation.
Total no. of breast fillets expected from 30 kg formulation = 96 packets of 250 gm weight
(including wastage and other loss).

**Expected sale proceeds**
Rate of sale of breast fillets @ Rs. 95/- per 250 g fillets
Total sale proceeds = 96 x 95 = Rs. 9120.00 per day
Net Income = Sale proceeds – total expenditure
= Rs. 9120.00 – Rs. 7780.00 = Rs. 1340.00
Net income per month (25 working days per month)
= Rs. 1340.00 × 25 = Rs. 33,500.00
Loan commitments for capital expenditure
Loan of Rs. 4.0 lakh, at interest @ 12% per annum for 5 years term = Rs. 4,48,000/-
Amount of loan payment per month = Rs. 4,48,000/60 = Rs. 7500.00
**Profit per month** = Net income – loan commitment
= 33,500 – 7500 = Rs. 26000.00
Selling price of fillets by producer = Rs. 95/- Per 250 g fillet and selling price of fillets by
retailer = Rs.105/- each 250 g packet. Suppose one retailer is selling total 12.5 kg breast fillet
(50 packets of 250 g) per day with a profit margin of Rs. 10.00/- per packet. Per day each
retailer profit = Rs. 500/- and in a month Rs. 15000. Thus, it is visible to generate
employment to two skilled persons and two unskilled persons @ Rs. 250/- and Rs. 150/- per
person per day respectively. It can additionally provide a profit to the tune of Rs. 26,000/- to
the processor, besides two retailers (each selling 12.5 kg breast fillets per day) who can also
derive a profit to the tune of Rs. 15000/- per retailer per month.

**Conclusion**
On the basis of physico-chemical parameters and sensory evaluations cooking time were
standardized for broiler breast fillets preparation. Standardized cooking method reported in
this study were 50 min. for hot air oven cooking, 40 min. for microwave grilling cooking, 10
min.for microwave cooking and steam cooking 40 min plus shallow frying 5 min. Microwave
grilling cooking method reported best for broiler breast fillets preparation on the basis of
physico-chemical parameters and sensory evaluations. Cost economics at current price
indicate that breast fillets obtained from broiler breeders, which is tough and has less demand and less market price, can be sold on a higher demand with premier price. So this could be a viable and profitable enterprise.

Acknowledgement-
ICAR-CARI for providing necessary inputs.

References