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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 sause 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 parametars 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) Parameters Treatments

Parameters	Treatments			
	T_1	T_2	T_3	T_4
Physicochemical quality				
pH	5.75 ± 0.002^{b}	5.78 ± 0.002^{c}	5.71 ± 0.002^{a}	5.78 ± 0.002^{c}
Moisture (%)	53.85 ± 0.05^{c}	55.29 ± 0.05^{d}	48.14 ± 0.10^{a}	52.47 ± 0.08^{b}
Cooking yield (%)*	76.03 ± 0.08^{c}	82.74 ± 0.07^{d}	55.18 ± 0.02^{a}	68.84 ± 0.08^{b}
Sensory evaluation**#				
Appearance & colour	6.83 ± 0.13^{ab}	7.67 ± 0.09^{b}	6.00 ± 0.18^{a}	6.67 ± 0.09^{a}
Texture	7.00 ± 0.001^{bc}	7.92 ± 0.03^{c}	6.00 ± 0.21^{a}	6.50 ± 0.14^{ab}
Flavour	6.58 ± 0.13^{a}	7.67 ± 0.09^{b}	5.83 ± 0.19^{a}	6.33 ± 0.09^{a}
Juiciness	6.67 ± 0.14^{a}	7.92 ± 0.03^{b}	5.83 ± 0.19^{a}	6.50 ± 0.14^{a}
Overall acceptability	6.67 ± 0.09^{b}	7.75 ± 0.07^{c}	5.67 ± 0.14^{a}	6.42 ± 0.13^{ab}

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

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

Total = Rs. 5986.00

Processing equipment cost:

S. No.	Equipments	Unit cost	Approx. cost
1	Grill machine	70,000	70,000
2	Stainless steel table	20,000	20,000
3	Digital weighing balance	18,000	18,000
4	Impulse sealer	5,000	5,000
			Total = Rs. 1,13,000

Storage equipments (for meat):

S. No.	Equipment	Unit cost	Approx. cost
1	Deep freezer (345 lit.)	150,000	150,000
2	Refrigerator (500 lit.)	60,000	60,000
3	Three wheeler (Van Rickshaw)	15000	15000
4	Containers, knives	-	50,000
		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 ete.)

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 – 7500.00 = 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.

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References

[1] Singh, T., Chatli, M.K., Kumar, P., Mehta, N. and Malav, O.P. 2015. Effect of different cooking methods on the quality attributes of chicken meat cutlets. *Journal of Animal Research*, **5**: 547-54.

[2] Verma, A.K., Pathak, V. and Singh, V.P. 2013. Cost of formulation for chicken meat noodles using whole wheat and rice flour. *Indian Journal of Poultry Science*, **48**: 261-64.

[3] Salama, N.A. 1993. Evaluation of two cooking methods and precooking treatments on characteristics of chicken breast and leg. *Grasas-y-Aceites*, **44**: 25-29.

[4] Hoda, I.S., Ahmad, S. and Srivastava, P.K. 2002. Effect of microwave oven processing, hot air oven cooking, curing and polyphosphate treatment on physico-chemical, sensory and textural characteristics of buffalo meat products. *Journal of Food Science Technology*, **39:** 240- 45.

[5] Sharma, D.P., Panda, P.C. and Ahlawat, S.S. 2005. Effect of additives and microwave cooking on quality of spent chicken meat patties. *Journal Food Science Technology*, **42**: 35-39.

[6] Nisar, P.U., Chatli, M.K., Sharma, D.K. and Sahoo, J. 2010. Effect of cooking methods and fat levels on the physiochemical, processing, sensory and microbial quality of buffalo meat cutlets. *Asian- Australian Journal of Animal Science,* **23**: 1380-85.

[7] Pawar, V.D., Khan, F.A., Agarkar, B.S. 2002. Effect of fat/whey protein concentrate levels and cooking methods on textural characteristics of chevon patties. *Journal of Food Science and Technology*, **39**: 429-31.

[8] Pawar, V.D., Khan, F.A. and Agarkar, B.S. 2000. Quality of chevon patties as infl uenced by different methods of cooking. *Journal of Food Science Technology*, **37**: 545-48.

[9] Raj, R., Sahoo, J., Karwasra, R.K. and Hooda, S. 2005. Effect of ginger extract and clove powder as natural preservatives on the quality of microwave oven cooked chevon patties. *Journal of Food Science Technology*, **42**: 362-64.