International Journal of Science, Environment and Technology, Vol. 5, No 5, 2016, 3603 – 3609

ISSN 2278-3687 (O)
2277-663X (P)

EFFECT OF VACUUM TUMBLING ON COOKING YIELD AND PHYSICAL PROPERTY OF TANDOORI PREPARED FROM BROILER MEAT

Dukare Sagar Popat[1*], G. Raj Manohar[1] N. Ramamurthy[1] and R. Narendrababu[2]

[1]Department of Poultry Science, Madras Veterinary College, Chennai -600 007, India

[2]Department of Livestock Products Technology (Meat Science), Madras Veterinary College, Chennai -600 007, India

Tamil Nadu Veterinary and Animal Sciences University

E-mail: bhagatsagar249@gmail.com

Abstract: Tandoori chicken was prepared by using vacuum tumbler (tumbling time 30min, 1 hr, 2hrs, 3hrs). Fresh meat and product were subjected to study the physical parameters. Results have indicated that product having 2hrs tumbling time have shown highly significant difference (P≥0.01) for cooking yield and marinate uptake. For fresh meat there is no significant difference between treatment and control for colour and Shear force Value. For Tandoori meat, there is highly significant difference (P≥0.01); 2 hrs tumbling product have very low Shear force value. There is no significant difference for colour but more tumbling time product have better colour than others.

Keywords: Tandoori, Tumbler, broiler, marinating, Shear force value.

Introduction

Tandoori Chicken is an Indian dish made by baking large pieces of chicken which have been marinated in spices and yogurt. It is traditionally made on skewers in a tandoor (Indian clay oven). Marination is used to improve both sensory (flavour, colour, moisture and texture) as well as functional properties of meat (water-holding capacity, stability and cooking yield). Marinades are preliminary a mixture of salt, organic acids, nitrites and spices in a solution in which meat is soaked. Skinless meat are marinated in a tumbler (massager), operated in a static, vacuum or high pressure to improve marinade absorption and uniformity (Sams, 2001). The agitation, which can be applied for one to several hours (slow or intermittent), helps to disrupt some of the tissue structure, assists in distributing the brine solution and develops a protein exudates that will later serve as “glue” to bind the meat chunks during cooking. Operating under vacuum helps in removing the air bubbles from the exudates and might also assists in protein extraction (Barbut, 2005). According to Treharne (1971), tumbling is defined as the massaging of meat surfaces and this process involves a transfer of kinetic energy and consequently causes alteration in muscle tissue.

*Received Sep 22, 2016 * Published Oct 2, 2016 * www.ijset.net*

According to Rust and Olson (1973), this protein exudate acts as a sealer when the protein is denatured during thermal processing. Vartorella (1975) and Krause (1976) added that this sealer helps to hold in juices during smoking and cooking, and results in increased yields, increased juiciness and improved slicing characteristics of the finished product. Other benefits of tumbling include improved tenderness and more uniform cured meat color (Krause, 1976).

Materials and Methods: The experiment was conducted in the Department of Poultry Science and Department of Livestock Products Technology, Madras Veterinary College, Chennai. In experimental phase, 12 trials with each five commercial broilers reared in Department of Poultry Science, Madras Veterinary College, Chennai were subjected for the study. Fresh meat and Tandoori prepared from that meat were subjected to Cooking yield and Physical property.

Processing of Tandoori chicken: Ingredients for tandoori chicken (Narasimha Rao *et al.,*1996) was used. Strict hygienic measures were followed while handling the carcass. Five birds were taken for each trial, out of that four birds were kept for treatments (0.5, 1, 2, 3 hours in vacuum tumbling) and one as control. The drained carcasses were rubbed with salt and lemon kept for 10 minutes at room temperature (27°C to 42°C). The dry and ground spices were blended with condiments (peeled onion, ginger and garlic). Finally curd was added and mixed thoroughly. Then the salted carcasses were immersed in the above mix and set aside for marination in the vacuum tumbler for a period of 0.5, 1, 2, 3 hours and one bird kept as control dipping in the marinade for 3 hours. After air drying**,** the marinated carcasses were hung in the earthen tandoori oven with the use of skews and cooked for 10 - 20 minutes at 250°C.

Cooking yield: Individual weight of marinated carcasses before and after cooking was recorded.

$$\text{Cooking yield} = \frac{\text{Weight of tandoori chicken after cooking}}{\text{Weight of marinated carcass before cooking}} \times 100$$

Hunter colour analysis : Colour of meat sample was measured using Hunter lab Mini scan XE plus Spectro-colorimeter (Model No. 45/O-L, Reston Virginia, USA) with geometry of diffuse/80 (sphere – 8mm view) and an illuminant of D65/10 deg (Bindu *et al*., 2007).

Shear Force Value (Kg/cm^2): Shear force value of the product was measured by a modified method described by Khan and Ryonakamura (1970).

Statistical analysis: Statistical analysis of the data obtained, was done using ANOVA technique according to the method described by Snedecor and Cochran (1994) by completely randomized design (CRD). Further, to determine the significance between treatments, Turkey's HSD test was conducted by a SPSS® – 20 software package.

Results and Discussion

The abbreviations used in results for treatments and control are as follows for control: Con; 30 min tumbling: T1, 60 min tumbling: T2 and 120min tumbling: T3, 180min tumbling: T4. Data presented in Table 2 indicate that there is no significant difference in live weight, dressed weight, dressing percentage between treatment group and control group.

Table-2: Mean ± SE of Cooking Yield (%) of Tandoori Chicken from Broiler Meat (n=24)

Parameter	Live weight (gm)	Dressed weight (gm)	Dressing (%)	Weight of marination + carcass (gm)	Marination uptake (gm)	Cooking weight(gm)	Cooking yield (%)
Control	2105.71 ± 60.37	1363.06 ± 55.03	64.35 ± 1.10	1465.04 ± 54.38	101.38^{a} ± 1.28	737.83^{a} ± 30.10	50.46^{a} ± 0.91
T1	1998.96 ± 34.27	1285.13 ±44.97	63.92 ± 1.39	1403.33 ± 44.39	118.21^{b} ± 2.97	854.25^{b} ± 27.46	60.85^{b} ± 0.29
T2	1953.08 ± 49.13	1262.05 ± 46.85	64.31 ± 1.22	1414.04 ± 45.89	151.50^{c} ± 2.93	998.79^{c} ± 32.69	70.63^{c} ± 0.23
T3	2064.67 ± 38.06	1340.71 ±46.09	64.59 ± 1.19	1539.75 ± 44.56	199.04^{d} ± 5.14	1155.83^{d} ± 34.19	75.06^{d} ± 0.99
T4	1916.21 ± 63.76	1239.21 ± 61.1	64.59 ±2.18	1429.33 ± 59.83	190.13^{d} ± 3.73	1031.25^{cd} ±60.99	72.14^{cd} ± 2.83
F Value	2.38^{NS}	1.05^{NS}	0.03^{NS}	1.03^{NS}	155.11**	17.00**	51.42**

Column bearing different superscripts differ significantly, n= number of observations

Marinate uptake (gm): There was highly significant difference between control and treatment of broilers. High marinate uptakes were found in T3 i.e 199.04 ± 5.14; by increasing tumbling time -there is marinate also increased and this result coincides with the finding of Froning and uptake also increasing. When tumbling time increased the marinate uptake (Ledward, 1979) increased. Tumbling disrupted muscle cells, thus facilitating the diffusion of curing ingredients into the meat (Babji *et al.,* 1982). Increased marination times were found to produce more acceptable end products with increased scores for colour, aroma and flavour attributes, (Yusop *et al.,* 2010) and (Pauli, 1979).

Cooking yield (%): There was highly significant difference between control and treatment of broilers. By increasing tumbling time, cooking weight is also increasing. Cooking yield of

chicken Tandoori of group Vacuum Tumbling-120 min (VT-120) was significantly (P<0.01) higher than the Control, Vacuum Tumbling-60 min (VT60) and Vacuum Tumbling-180 min (VT180) groups. This result is in agreement with the findings of Dzudie and Okubanjo (1999) who reported that the product tumbled for a longer time had a lower cooking loss, when compared to those cooked for a short time due to increased amount of extractable soluble proteins. Muller (1991) also reported higher product yield due to tumbling as compared to non-tumbled control. Increased tumbling time provides better chances for migration of curing solution in increased ionic strength and pH, which in turn enhance the product yield. Ghavimi *et al.* (1986) observed insignificant difference between product yield from vacuum and aerobically tumbled meats. These data agree with the report of Rust and Olson (1973) who felt that the exudates of myofibrillar protein seals moisture in the product as it coagulates on and immediately below the surface.

Table 3: Mean ± SE of Colour and Shear Force Value of Broiler Fresh Meat (n=24)

Parameter	Lightness	Redness	Yellowness	Shear Force Value (Kg/cm^2)
Carcasses for Control	53.50 ± 1.48	7.59 ± 0.58	18.49 ± 0.88	6.73 ± 0.19
Carcasses for T1	57.67 ± 1.46	7.72 ± 0.59	19.46 ± 0.84	5.69 ± 0.26
Carcasses for T2	56.07 ± 1.14	8.47 ± 0.49	20.28 ± 0.72	6.25 ± 0.19
Carcasses for T3	56.04 ± 1.15	8.26 ± 0.66	19.08 ± 0.96	5.72 ± 0.27
Carcasses for T4	54.63 ± 0.98	9.15 ± 0.54	20.93 ± 0.39	6.18 ± 0.18
F Value	1.59^{NS}	1.18^{NS}	1.00^{NS}	3.68^{NS}

Column bearing different superscripts differ significantly. n= number of observations
NS- Not significant (P>0.05)

Table 4: Mean ± SE of Colour and Shear Force Value of Broiler Meat Tandoori (n=24)

Parameter	Lightness	Redness	Yellowness	Shear Force Value (Kg/cm^2)
Con	47.92 ± 1.39	24.81 ± 0.41	34.15 ± 0.511	4.60^{c} ± 0.23
T1	44.99 ± 0.90	28.33± 1.43	35.30 ± 0.71	4.05^{bc} ± 1.35
T2	44.70 ± 0.79	26.88 ± 0.68	32.90 ± 0.54	2.33^{ab} ± 0.33
T3	44.16 ± 0.94	25.95 ± 0.91	32.13± 1.08	2.11^{a} ± 0.30
T4	46.49 ± 1.09	25.81 ± 0.82	33.43 ± 0.51	2.01^{a} ± 0.20
F Value	2.17^{NS}	2.11^{NS}	2.97^{NS}	3.48*

Column bearing different superscripts differ significantly. n= number of observations
NS-Not significant (P>0.05); *-Significant (P<0.05);

Lightness: There was no significant difference between control and treatment observed both in fresh meat and product obtained from that meat. Lightness was reduced in products as compared to fresh meat. In this study lightness was reduced in product as compared to fresh meat as stated by Qiao *et al.,* (2002), lightness reduced due to the marinate ingredient and cooking as reported by Serdaroglu, 2005 and Qiao *et al.,* (2002). Lightness of meat product was positively correlated with cooking loss and negatively correlated with water holding capacity (Barbut, 1993).

Redness: There was no significant difference between control and treatment observed both in fresh meat and product obtained from that meat. Redness was increased in products as compared to fresh meat. The colour of cooked meat products arise mainly from pigmentation of the meat from which they were made and the ingredients used in the processing (Serdaroglu, 2005). Redness was an important characteristic for consumer acceptance (Maga, 1994). Absolute colour values changed with marination and cooking (Qiao *et al.,* 2002). Extreme colour variations, from very light to very dark, had significant effects on functional properties and chemical composition of broiler breast meat (Qiao *et al.,* 2001).

Yellowness: There was no significant difference between control and treatment observed both in fresh meat and product obtained from that meat. Yellowness was increased in products as compared to fresh meat. Product colour may be due to the ingredient used and cooking.

Shear Force Value: There was no significant difference between control and treatment observed in fresh meat. In this study shear force value was decreased in product as compared

to raw meat and in case of product as compared to control product have less shear force value. Improvement in shear force value in tumbled product might be due to cellular disruption and myofibrillar fragmentation of the muscle tissue (Babji *et al.,* 1982). Toughening effect was due to hardening of myofibrillar proteins (Laakkonen, 1973). Greater variability in shear values of raw samples as compared to those of cooked meat was observed by McBee and Naumann (1959). According to Krause (1976), tumbling improved tenderness and more uniform cured meat colour.

Conclusion

Two hour tumbling help to improve marinate uptake, cooking yield, Shear Force Value. Thus it was concluded that study has been said to have beneficial role in improving tandoori quality. From the above study, it is recommended that two hour vacuum tumbling can be adopted for commercial and large scale production.

References

[1] AOAC., 1984. Official Methods of Analysis. 16th edn. Association of official Analytical Chemists, Will Behington, D.C.

[2] Babji AS, Froning GW and Ngoka DA (1982). The effect of short term tumbling and salting on the quality of turkey breast meat. *Poult. Sci.,* 61: 300-303.

[3] Barbut S.,2005. Poultry products processing. First Indian reprint. CRC press LLC.

[4] Barbut, S., 1993. Colour measurements for evaluating the Pale Soft Exudative (PSE) occurrence in turkey meat. *Food Res. Int.* **26**: 39–43.

[5] Dzudie T and Okubanjo A, 1999). Effect of rigor state and tumbling time on quality of goat hams. *J. Food Engr.,* 42: 103-107.

[6] Egbert WR, Huffman DL, Chen, CM and Jones WR.,1992. Microbial and oxidative changes in low fat ground beef during simulated retail distribution. *J. Food Sci.,* 57(6): 1269-1274, 1293.

[7] Ghavimi B, Roigers RW, Althan TG and Ammerman GR, 1986. Effects of non-vacuum, vacuum and nitrogen back flush tumbling on various characteristics of restructured cured beef. *J. Food Sci.,* 51: 1166-1168.

[8] Khan, A.W., 1971. Effect of temperature during post-mortem glycolysis and dephosphorylation of high energy phosphates on poultry meat tenderness. *J. Food Sci.,* **36**: 120-121(Quoted in *Poultry. Sci*., **68:**1588-1591).

[9] Krause R.,1976. Influence of tumbling and sodium tripolyphosphate on quality, yield and cure distribution in hams. M.Sc. Dissertation. The Ohio State University, Columbus, OH. USA.

[10] Ledward DA., 1979. Meat. Effect of heating on foodstuffs. In R.J. Priestley (ed.). London: Applied Science Publishers, pp. 121-157.

[11] Maga, J.A., 1994. Pink discoloration in cooked white meat. *Food Rev. Int*., **10:** 273–286. Mc Bee and H.D. Nauman, 1959. The influence of freezing on shear and taste panel evaluation of beef. *J. Anim. Sci*., **18**: 1471.

[12] Narasimha Rao, D and V. Sreenivasamurthy, 1986. A preliminary study of the effect of urea in the preservation of meat. *Meat. Sci.,* **17:** 251-265.

[13] Pauli, P. C., 1979. Classical cooking the modern way CBI. Pubi. Co. Inc Boston M. A.

[14] Qiao, M., D.L. Fletcher, D.P. Smith and J.K. Northcutt, 2002. Effects of Raw Broiler Breast Meat Color Variation on Marination and Cooked Meat Quality. *Poultry Sci.,* **81**: 276–280.

[15] Qiao, M., D.L. Fletcher, D.P. Smith and J.K. Northcutt, 2001. The effect of broiler breast meat color on pH, water-holding capacity and emulsification capacity. *Poultry Sci*., **80**: 676–680.

[16] Rust R.E, and D.G, Olson, 1973. Meat curing principles and modern practice. Koch supplies, Inc., Kanas city.

[17] Sams AR (2001). Poultry meat processing edition, Boca Raton, Florida, USA, CRC Press.

[18] Serdaroglu, M., G. Yildiz-Turp and K. Abrodimov, 2005. Quality of low fat meatballs containing legume flour as extenders. *Meat Sci.,* **70**: 99-105.

[19] Snedecor GW, Cochran WG (1994). Statistical methods. First East West press edition, New Delhi.

[20] Treharne T., 1971. Growing interest in Meat tumbling. Food manufacture, October, pp. 35-39.

[21] Vartorella T., 1975. Canned pork. M.Sc. Dissertation. The Ohio State Uni. Columbus, OH. USA.

[22] Yusop, S.M., M.G.O. Sullivan, J.F. Kerry and J.P. Kerry, 2010. Effect of marinating time and low pH on marinade performance and sensory acceptability of poultry meat. *Meat Science,* **85**: 657-663.