

Original Research Article

Application of hurdle concept in development and shelf life enhancement of chicken lollipop

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ABSTRACT

Keywords

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stability;
quality.

The application of hurdle concept in lollipop development was tried. Various types of hurdles viz. marination, cooking and use of glycerol were incorporated in the process of chicken lollipop manufacturing. The chicken wings and other ingredients used in experiments were collected from local market Mathura. Tapered wing tip and first joint was located which is then cutted through the soft cartilage. The skin is then cut all around with the use of knife to scrape down the meat from the bone. Cutting was done through a couple of sinews and then meat was pushed down to the other end. Thus the wing cut of poultry was shaped into lollipop. In experiment there were three different combinations used i.e. control (T₁) (lollipop without glycerol), T₂ (lollipop with glycerol and corn flour) and T₃ (lollipop with glycerol and bread crumbs). There were no significant difference observed in the control using corn flour and bread crumbs so only one control was compared with T₂ and T₃ products using various parameters. The study overall revealed great reduction in water activity of the lollipops contains glycerol in comparison to the control. The content of protein was also higher in these products as compared to control products which might be due to better binding property by using egg contents. The total plate count was also less in these products in comparison to the control. The pH and TBARS were also estimated during storage of 12 days under refrigeration. Thus it revealed longer shelf life of the products using glycerol. Use of hurdle technology in development of lollipop gives better option for its development, enhancement of shelf life and better quality achievement.

Introduction

Meat is highly nutritious food eaten by human beings since time immemorial. Poultry meat is highly digestible and very well recognized nutritious food due to

abundant high quality protein, B-complex vitamins and important minerals especially iron but low in fat and calories than meat from other species, and for this, it has

occupied a special place in the diet Varela et al. (1988). Now the children, women and highly mobilized populations required ready to eat, variety and delicious food. Besides nutrition, chicken meat has a great appeal because of its flavour, texture and delicacy. Chicken meat is free from social taboos and liked equally by all age groups persons. Chicken lollipop is among the meat products most liked by the children because it provides convenience and variety to the meat products and relished by the children (Brimelow, 1985). Poultry wings are most appropriate meat cuts to be used for lollypop development (Mach et al., 2008).

Hurdle technology is a use of combinations of preservative techniques to enhance its microbial stability and also to enhance the sensory qualities as well as their nutritional and economic properties (Leistner, 2000). So the concept of hurdles was utilized in preparation of chicken lollipops with the aim to enhance the eating quality and shelf life. For that purpose glycerol was added to reduce the water activity and for the improvement of sensory qualities as suggested by Brimelow (1985) that it lowers the water activity. Another hurdle parameter which was used in the study was marination to enhance its texture, taste, colour and overall quality of meat products (Pearson and Gillett, 1997). Third hurdle which was used in the study was cooking. The cooking technique further enhances the palatability, acceptability and digestibility of the meat products (Sharma and Nanda, 2002).

Materials and Methods

The study was conducted to increase the shelf life of lollipops using combination of hurdles. The chicken wings and other

ingredients used in experiments were collected from local market Mathura. Tapered wing tip and first joint was located which is then cutted through the soft cartilage. The skin is then cut all around with the use of knife to scrape down the meat from the bone. Cutting was done through a couple of sinews and then meat was pushed down to the other end. Thus the wing cut of poultry was shaped into lollipop. In experiment there were three different combinations used i.e. control (T₁) (lollipop without glycerol), T₂ (lollipop with glycerol and corn flour) and T₃ (lollipop with glycerol and bread crumbs). There were no significant difference observed in the control using corn flour and bread crumbs so only one control was compared with T₂ and T₃ products using various parameters. The chicken wings shaped in lollipop were then marinated for two hours in marination solutions as mentioned in table1. After marination lollipop were rolled over the corn flour/bread crumbs followed by cooking at 180⁰C for 27 minutes in oven. Developed lollipops were subjected to physico-chemical, microbiological and sensory evaluation. The proximate analysis was performed according to the standard procedure of AOAC (1995). Cooking characteristics were estimated by the method as described by Kumar and Sharma (2004). Sensory evaluation was done using 8-point hedonic scale. The products prepared in the experiments were then subjected to the storage study and qualities of products were observed in terms of pH by APHA (1992) and Thiobarbituric acid vales (TBARS) by the procedure of Tarladgis *et al.* (1960) for 12th day of storage at the interval of 3 days. All the experiments were conducted three times in duplicate (n=6). Finally statistical analysis of the data was carried out for one way ANOVA for fresh

products and two ways ANOVA for storage studies data and level of significance was estimated by using SPSS-14 software and method followed by Snedecor and Cochran (1994).

Results and Discussion

Proximate analysis

The data obtained on proximate analysis in the study showed percent range in between 59.94 ± 0.21 to 61.32 ± 0.18 , 5.98 ± 0.01 to 6.09 ± 0.01 , 11.44 ± 0.12 to 13.56 ± 0.37 , 0.99 ± 0.04 to 1.10 ± 0.03 and 0.78 ± 0.15 to 0.89 ± 0.12 for moisture, fat, protein, ash and water activity, respectively. There was no significant difference observed in the fat contents in product T₂ and T₃ while significant (P<0.05) difference was observed in these values with the control. That might be due to variation in fat retaining in the products. The contents of ash were also non significantly different in all three products. Moisture content of product control and T₂ were non significantly different among each other. However, significant (P<0.05) differences were observed in these values with moisture content of T₃ product. Protein values of all three products were found significantly (P<0.05) different among each other. That might be due to variation in ingredients used and better binding with egg ingredients. The better cooking yield also observed in product T₂ in comparison to other combinations.

Sensory evaluation

The sensory scores obtained on colour and appearance, flavour, texture and coating of products T₂ and T₃ showed non significant differences among each other while these scores were significantly different from control. However, scores for saltiness and

overall acceptability in all three combinations found significantly (P<0.05) different among each other. Among all the lollipops developed using bread crumbs showed highest scores and liked most among all combinations. That might be due to crunchy and suitability of snacks likes quality of the later product.

Microbiological examination

Microbiologically all three products were safe for consumption but very lower count were observed in the lollipops using glycerol than the control. There were negligible coliform and yeast and mould noticed in the products. However, during storage significant (P<0.05) differences were observed among the days of storage and treatments. Overall the products treated with glycerol showed microbiological stability as compared to control.

Storage studies

pH

The mean pH values of all three types of chicken lollipop increased gradually with the advancement of storage days. The pH values of control lollipop were in the range of 5.53 ± 0.11 to 5.79 ± 0.16 while the values of pH for chicken lollipop were in the range of 5.70 ± 0.02 to 6.02 ± 0.09 and 5.95 ± 0.02 to 6.04 ± 0.06 in T₂ and T₃ lollipops. Among the comparison of all the products days wise and product wise revealed non significant among the treated products and also among the days of storage for these products. However, significant (P<0.05) differences were observed in pH of control in the lollipops stored at 0, 3 from products of day 9th and 12th but there were similar pH values

noticed in the lollipops stored on 0,3,6 and products of 6,9 and 12th day of storage.

TBARS

The significant effect of using glycerol was noticed in lollipops during storage on the TBARS values. The range of TBARS noticed in the lollipops were 0.20 ± 0.01 to 0.89 ± 0.02 in control, 0.13 ± 0.02 to 0.83 ± 0.03 in product T2 and 0.18 ± 0.01 to 0.74 ± 0.03 in product T3. Overall significant ($P<0.05$) differences were recorded in the TBARS values in all the products stored upto 12th day at the interval of three days. Among the treatments significant ($P<0.05$) differences were observed in TBARS of products in each day of storage except on day 0 where treatment products were non significantly different.

The highest moisture contents in control are due to higher contents of moisture in the meat. It is also higher in the lollipops prepared from corn flour as compared to the bread crumbs which might be again due to less moisture contents and better binding of corn with meat as compared to the bread crumbs. Fat contents in the treated products (T3) were maximum which might be due to the higher fat contents in breeds as compared to the control and corn. Protein content was reported highest in product T2 due to higher protein in corn and its better binding property with meat. Water activity in the treated products (T2 and T3) was highest as compared to the control because of the use of glycerol in products which acts as the humectants and lowers the water activity. Cooking yield in product T2 was highest than other treatments which might be due to better binding of corn with meat and less moisture loss. It

might be due to better compatibility of corn with meat. The results obtained on proximate analysis in study were very close to the values of (Singh *et al.*, 1989) on chicken meat sticks and (Kapsalis *et al.*, 1989) with enrobed meat products. The water activity values of the products T₂ and T₃ were significantly ($P<0.05$) lower than control. Water activity values were almost same as suggested by Brimelow (1985) during preparations of intermediate moisture meat products.

The sensory attributes of all the products whether control or treated were every well accepted by the panellists. The highest scores for sensory evaluation were for bread crumbs treated lollipops than other treatments. Lowest scores were for control. Sensory profile of the study was closed to the findings of Varela (1988) during study on enrobed meat products.

The microbiologically all products were found sound. It might be due to the use of hurdle technology to enhance the shelf life of the products. The cumulative effects of glycerol, cooking, curing and preservation enhanced the shelf life from few days to twelve days without appreciable changes in the quality.

These variations in pH values in different lollipops were in the accordance of the study conducted by Ravi *et al.* (2013) and Ismail *et al.* (2008). The variation in the pH values were due to the effect of glycerol and the corn and bread crumbs used in the product development. The variation in TBARS in different products as shown in results were very close to the reports of Ravi *et al.* (2013) and Kumar and Sharma (2004). The differences in values of TBARS in control and treated products noticed in lollipops were due to the effect of glycerol and other hurdles applied in the product development.

Table.1 Formulation for lollypop preparation

Ingredients	T1	T2	T3
Chicken wings (g)	100	100	100
Egg liquid (g)	25	25	25
Glycerol (ml)	-	1.5	1.5
Corn flour/ bread (g)	15	15	15
Condiments (g)	10	10	10
Black pepper (g)	0.5	0.5	0.5
Salt (g)	2	2	2
Lemon juice(ml)	5	5	5
Red Chile powder (g)	2.5	2.5	2.5

T1= Control T2= Glycerol + Corn flour T3= Glycerol + Bread crumbs

Table.2 Mean proximate analysis of chicken lollypop

Parameters	T1	T2	T3
Moisture (%)	61.32 ^a ±0.18	61.05 ^a ±0.09	59.94 ^b ±0.21
Fat (%)	5.98 ^b ±0.01	6.07 ^a ±0.03	6.09 ^a ±0.01
Protein (%)	12.57 ^b ±0.22	13.56 ^a ±0.37	11.44 ^c ±0.12
Ash (%)	1.04±0.08	0.99±0.04	1.10±0.03
Water activity(a _w)	0.89 ^b ±0.12	0.78 ^a ±0.15	0.80 ^a ±0.11
Cooking yield (%)	79.12 ^b ±0.15	82.71 ^a ±0.48	81.67 ^a ±0.22
Cooking loss (%)	21.00 ^a ±0.15	17.19 ^c ±0.47	18.32 ^b ±0.22
n=6			

Values showing different superscripts column wise differ significantly (P<0.05)

Table.3 Mean sensory profile of chicken lollypop

Treatments	Colour and appearance	Flavour	Texture	Coating	Saltiness	Overall Acceptability
T1	6.00 ^a ±0.09	5.67 ^a ±0.19	5.83 ^a ±0.06	5.67 ^a ±0.08	5.67 ^a ±0.19	5.67 ^a ±0.27
T2	6.17 ^b ±0.29	6.17 ^b ±0.15	6.17 ^b ±0.12	5.50 ^b ±0.13	5.93 ^b ±0.23	5.90 ^b ±0.21
T3	6.50 ^b ±0.17	6.33 ^b ±0.16	6.17 ^b ±0.18	5.83 ^b ±0.21	6.33 ^c ±0.13	6.50 ^c ±0.08
n=21						

Values showing different superscripts column wise differ significantly (P<0.05)

Table.4 Mean pH values of chicken lollipops as influenced by type of treatment and storage time under refrigerated storage (4±2⁰C)

Treatments	Storage period (days)				
	0	3	6	9	12
T1	5.53±0.11 ^{Ab}	5.65±0.17 ^{Ab}	5.65±0.17 ^{ABb}	5.79±0.21 ^{BCb}	5.79±0.16 ^{BCb}
T2	5.70±0.02 ^a	5.86±0.03 ^a	6.00±0.03 ^a	6.00±0.08 ^a	6.02±0.09 ^a
T3	5.95±0.02 ^a	5.99±0.03 ^a	6.01±0.03 ^a	6.04±0.05 ^a	6.04±0.06 ^a
n=6					

Means with different uppercase superscripts in the same row and lowercase superscripts in the same columns are significantly different (P<0.05)

Table.5 Mean TBARS values of chicken lollypop as influenced by type of treatment and storage time under refrigerated storage ($4\pm 2^{\circ}\text{C}$)

Treatments	Storage period (days)				
	0	3	6	9	12
T1	0.20±0.01 ^{Aa}	0.39±0.02 ^{Bb}	0.69±0.02 ^{Cc}	0.81±0.02 ^{Db}	0.89±0.02 ^E
T2	0.13±0.02 ^{Ab}	0.34±0.02 ^{Bc}	0.63±0.02 ^{Cd}	0.75±0.02 ^{Dc}	0.83±0.03 ^{Ec}
T3	0.18±0.01 ^{Aab}	0.26±0.02 ^{Ba}	0.53±0.02 ^{Ca}	0.72±0.02 ^{Da}	0.74±0.03 ^{Ea}

n=6

Means with different uppercase superscripts in the same row and lowercase superscripts in the same columns are significantly different ($P<0.05$)

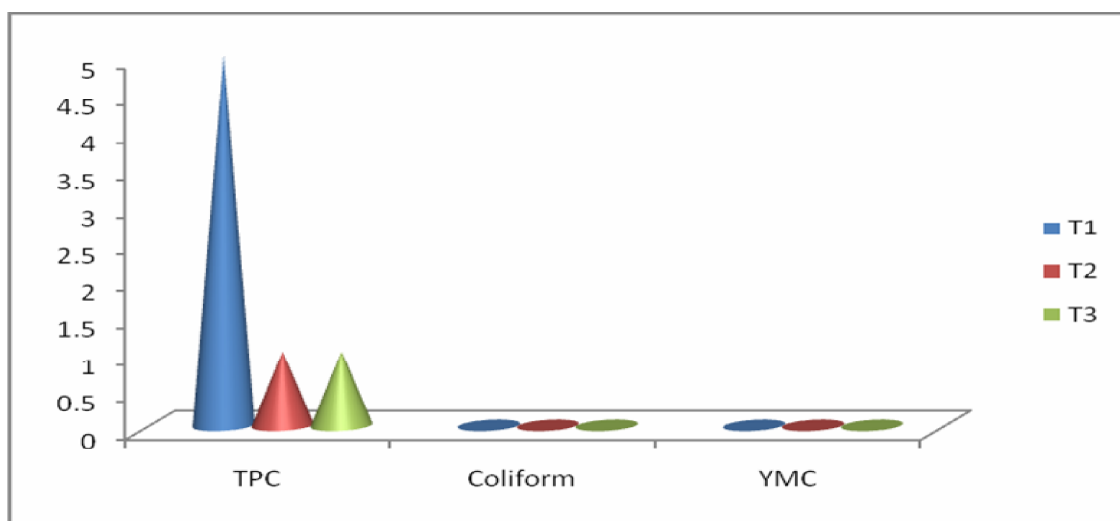
Table.6 Mean Microbiological values of chicken lollypop as influenced by type of treatment and storage time under refrigerated storage ($4\pm 2^{\circ}\text{C}$)

Treatments	Storage period (days)				
	0	3	6	9	12
Total Plate Count (log CFU/g)					
T1	0.93 ^D ±0.19	2.22 ^C ±0.14	2.86 ^B ±0.02	3.86 ^{Aa} ±0.02	3.96 ^{Aa} ±0.02
T2	0.79 ^D ±0.26	2.00 ^C ±0.05	2.87 ^B ±0.07	3.62 ^{Ab} ±0.04	3.89 ^{Ab} ±0.04
T3	0.88 ^D ±0.18	2.08 ^C ±0.18	2.96 ^B ±0.03	3.72 ^{Ab} ±0.04	3.92 ^{Ab} ±0.04
Yeast and Mold Count (log CFU/g)					
T1	0.00 ^C ±0.00	0.33 ^C ±0.21	0.93 ^{Ba} ±0.19	1.72 ^{Aa} ±0.03	1.92 ^{Aa} ±0.03
T2	0.00 ^C ±0.00	0.00 ^C ±0.00	0.50 ^{Bab} ±0.22	1.28 ^{Aa} ±0.06	1.68 ^{Aa} ±0.06
T3	0.00 ^B ±0.00	0.16 ^B ±0.16	0.38 ^{Bab} ±0.24	1.10 ^{Ab} ±0.06	1.60 ^{Ab} ±0.06

n=6

Means with different uppercase superscripts in the same row and lowercase superscripts in the same columns are significantly different ($P<0.05$)

Fig.1 Microbiological profile of chicken lollypop



The study mainly based on the effect of hurdles like marination, cooking and use of glycerol on lollypop product. In study we found great reduction in the water activity of the lollypops contains glycerol in comparison to the control. The protein value was also higher in these products which might be due to better binding property by using egg contents. The TPC count was also less in comparison to the control. The products prepared and subjected for storage under refrigeration were found quite stable upto 12th day, there after some spoilage signs were appeared so it was not analysed further.

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