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Research Article

EFFECT OF DIFFERENT ACIDULANTS ON PHYSICO-CHEMICAL PROPERTIES OF SHELF STABLE CHICKEN PICKLE

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ABSTRACT

The present study was carried out to evaluate the effect of acidulants like lactic acid at 1.0% level (LA), acetic acids at 1.0% level (AC) and citric acid at 0.5% level (CA) on shelf stable chicken meat pickle. Chicken meat pickle was prepared as per method, prescribed by Das *et al.* (2013) with slight modifications. An attempt was made to improve the sensory and quality characteristics of steam cooked chicken pickle by incorporating acidulants. It was found that the pH and titrable acidity values of CA were significantly lower and higher, respectively than AC and LA. LA and AC had significantly higher moisture and lower ash content and water activity than control and CA. Shear force values of treatments were significantly lower than control. Colour and appearance, flavour, juiciness and overall acceptability scores of control and LA were significantly higher than CA and AC. It can be concluded that chicken pickle incorporated with 1% lactic acid was selected as the best treatment on the basis of sensory scores.

Keywords: Acidulant, Chicken pickle, Sensory evaluation, Shelf stable, Water activity

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Chicken meat pickle is a shelf stable intermediate moisture type product. It is value added convenient product containing various ingredients like meat, spices, condiments, oil, vinegar and other food additives. Cooking and frying during pickle making denatures meat proteins and decreases water holding capacity of meat resulting in loss of water and increase its shelf life. Chicken meat pickle has appreciable sensory quality with lower microbial, yeast and mould counts. However, quality characteristics of chicken pickle are also dependent on characteristics of meat, formulation and processing technique as well as time/temperature evolution during cooking. An important phenomenon that is crucial to hurdle technology is homeostasis of microorganisms. Homeostasis is the constant tendency of microorganisms to maintain a stable and balanced (uniform) internal environment.

Preservative factors functioning as hurdles can disturb one or more of the homeostasis mechanisms, thereby preventing micro-organisms from multiplying and causing them to remain inactive or even die. Some of the hurdles such as temperature (high or low), water activity (aw), preservatives (nitrite, sorbate), competitive microorganisms (lactic acid bacteria) and acidity (pH) have been empirically used for years to stabilize meat, fish, milk and vegetables (Leistner, 2000). Reduced aw and pH are the two major hurdles contributing to shelf stability of meat pickles.

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Acidified products may limit microbial growth or survival depending on the types of microorganisms harboured in the food and the type and amount of acid used. Fermentation and addition of organic acids have been used as a preservation method since ancient times to increase acidity of foods. Organic acids are more effective preservatives in undissociated state. Lowering the pH of a food increases the effectiveness of an organic acid as a preservative. Citric acid, acetic acid, lactic acid etc. are organic acids world widely used for bio preservation of meat and meat products. The effect of lactic acid on products is associated to changes in acid/base equilibrium, the donation of protons and interferences of cell energy production. Acetic acid (vinegar) is generally regarded as safe (GRAS) and is a potent antimicrobial that has been used to control Salmonella contamination in meat and poultry products (Mani-Lopez *et al.*, 2012). It is used in meat products to slow the growth of spoilage bacteria and assist in the inhibition of pathogen survival and growth. Khade *et al.* (2019) studied the quality attributes and storage quality of spent hen meat pickle andconcluded that 0.5% citric acid and 0.5% lactic acid levels were more suited as an acidulants in the preparation of spent hen meat pickle and could be stored safely up to 60 days of storage at ambient temperature (37±1° C). The method of antibacterial effect of these organic acids varies on concentration, temperature and the method of application.

The aim of present work was to study the effect of

different acidulants i.e. acetic acid, lactic acid and citric acid on physico-chemical properties, colour and textural parameters and sensory score of shelf stable chicken meat pickle.

MATERIALS AND METHODS

The experiments were conducted in the Department of Livestock Products Technology, College of Veterinary Science and Animal Husbandry, DUVASU, Mathura. Live spent poultry birds were procured from Department of Poultry Science, DUVASU, Mathura. These birds were taken, given rest for 1-2 hours and then slaughtered at Meat Processing Laboratory following the standard procedure (Halal method). The lean carcass was eviscerated and dressed carcass was kept for conditioning in a refrigerator at 4±1º C for 4–6 hours and then frozen at -18º C till further processing. All other ingredients like salt, mustard oil, vinegar, spices of Agmark grade and condiments etc required for product preparation were procured from local market of Mathura. All the chemicals used in the study were procured from Hi Media Laboratories (P) Ltd, Mumbai, India. Thermo rigid air tight PET containers were sourced from local market for packaging and were pre-sterilized by exposing to U.V. light for 30 minutes before use.

Preparation of chicken pickle: The chicken pickle was prepared using Das *et al.* (2013) method with slight modifications (Singh *et al.*, 2019). Thawed chicken meat were cut into 1-2 inch chunks, and marinated with 1% salt and 1% turmeric powder for 30 minutes. The marinated chicken meat was then steam cooked (without pressure) for 15 min at 175±5° C in pre-warmed mustard oilto get golden brown colour. In a separate kadahi containing prewarmed oil, mustards seeds, condiments, spice mix and salt were added consecutively followed by addition of fried meat chucks and vinegar and cooked for 5 minutes. The pickle was cooled to room temperature and packed in a pre-sterilized air tight PET container, with the remaining heated mustard oil filled to the top without leaving any air space. Chicken pickle was left for next 2 days at ambient temperature for maturing and then used for further analysis. The formulation used for preparation of chicken pickle is given in Table 1.

Analysis of product: Developed chicken pickle was evaluated for various physico-chemical properties as per standard procedures. The pH of chicken meat pickle was determined as per Trout *et al.* (1992) method. Titrable acidity was determined as per Fisher and Peters (1968). Proximate composition such as moisture, fat, protein and ash percentage were evaluated as per AOAC (1995). Water activity of sample was measured by Aqua LAB dew point water activity meter 4TE. The colour parameters of the samples were measured using Hunter colorimeter of Color Tech PCM+ (Color Tec Associates Inc. Clinton NJ, USA). The coin shaped lance of instrument attached to software was directly put on the surface of chicken meat pickle at randomly chosen six different points (Hunter and Harold, 1987). Textural profile analysis, i.e. shear force value, was evaluated and measured with the help of instrumental texture profile analyzer (TA.HD Plus Texture Analyser) as per Bourne (1978). Sensory evaluation was carried out using eight-point hedonic scale with 8 = extremely desirable and 1 = extremely poor (Keeton, 1983).

A sensory panel (semi-trained) of seven judges drawn from post-graduate students and faculty of Veterinary College, DUVASU, Mathura, India, were requested to evaluate the product for different quality attributes *viz*., colour and appearance, texture, flavour, texture, juiciness, saltiness, sourness and overall acceptability in sensory room of department. Plain lukewarm water was given for mouth rinsing in between sensing two samples. The freshly prepared chicken meat pickles after ageing were given for sensory evaluation at normal room temperature in late afternoon around 4:00 p.m. A total of three replications were carried out, with each analysis done in duplicate (n = 6), except sensory studies where seven sensory panelists did sensory evaluation three times and n = 21 observations were recorded for each sensory attribute.

Statistical analysis: The data generated from various trials under each experiment were pooled and analyzed by statistical method of one way-ANOVA and mean±S.E using SPSS-16.0 software package and sub-class of means were compared by using Dunkan's multiple range test at 5% level (Dunkan, 1955).

RESULT AND DISCUSSION

Physico-chemical properties

The effects of different acidulants on physico-chemical properties of chicken meat pickle are presented in Table 2. The pH values of control were significantly higher and titrable acidity was significantly lower than treatments. Among the treatments, CA had significantly lower pH and higher titrable acidity than AC and LA whereas there was no significant difference between AC and LA for these parameters. Moisture content of control was significantly lower however ash content and water activity were significantly higher than treatments. Higher moisture content in treatments might be due to pH of products below isoelectric point of meat resulting into water retention in muscle proteins. Aktas *et al.* (2003) also reported increased water binding capacity of organic acids during marination of meat. There was no significant

difference in protein and fat content between control and treatments. Khade *et al.* (2019) studied the physico-chemical properties of spent hen meat pickle prepared from different acidulants and found that there were no significant difference in pH and titrable acidity values of control and treatments but TBA value of 1% acetic acid incorporated meat pickle were significantly lower than 0.5% citric acid or 0.5% lactic acid incorporated meat pickle.

Table 1. Formulation used for preparation of chicken meat pickle

S.N.	Ingredients	Weight (gm)
1.	Chicken meat	1000 gm
2.	Mustard oil	500 gm
3.	Salt	30 gm
4.	Dry Spice mix	30 gm
5.	Condiments	80 gm
6.	Vinegar	100 ml
7.	Turmeric powder	10 gm
	Total	100

Table 2. Effect of different acidulants on physico-chemical properties (Mean±SE) of chicken meat pickle

Parameters	C	AC	CA	LA	Treatment Mean
pH	5.32^{a}±0.04	4.79^{b}±0.03	4.64^{c}±0.03	4.89^{b}±0.02	4.91±0.05
Titrable acidity	0.81^{c}±0.05	0.89^{b}±0.02	1.02^{a}±0.03	0.85^{b}±0.02	0.89±0.04
Moisture (%)	43.68^{c}±0.22	46.80^{a}±0.15	44.26^{b}±0.09	47.39^{a}±0.11	45.53±0.18
Protein (%)	18.59±0.44	17.42±0.69	17.58±0.56	17.19±0.44	17.69±0.42
Fat (%)	28.19±0.04	27.91±0.06	27.45±0.06	26.70±0.04	27.56±0.13
Ash (%)	6.79^{a}±0.06	5.96^{b}±0.03	6.71^{a}±0.04	5.84^{b}±0.03	6.33±0.09
Water activity (aw)	0.948^{a}±0.05	0.931^{c}±0.02	0.939^{b}±0.09	0.928^{c}±0.06	0.936±0.05

Overall means bearing different superscripts in a row (a, b, c, d) differ significantly (P<0.05)

Table 3. Effect of different acidulants on colour and textural parameters (Mean±SE) of chicken meat pickle

Parameters	C	AC	CA	LA	Treatment Mean
Lightness (L*)	30.96^{a}±0.79	27.95^{ab}±0.49	25.53^{b}±0.92	29.19^{a}±0.61	28.40±0.23
Redness (a*)	4.96^{c}±0.16	6.19^{b}±0.23	7.78^{a}±0.28	5.81^{b}±0.33	6.18±0.67
Yellowness (b*)	5.87^{a}±0.30	4.90^{ab}±0.43	3.97^{b}±0.25	5.35^{a}±0.51	5.02±0.44
Shear force (N/cm^2)	63.55^{a}±0.27	56.86^{b}±0.63	59.91^{ab}±0.35	53.37^{c}±0.40	58.42±0.31

Overall means bearing different superscripts in a row (a, b, c, d) differ significantly (P<0.05)

Table 4. Effect of different acidulants on sensory attributes (Mean±SE) of chicken meat pickle

Attributes	C	AC	CA	LA	Treatment Mean
Colour andappearance	7.31^{a}±0.02	7.18^{b}±0.01	7.03^{c}±0.01	7.29^{a}±0.01	7.20±0.01
Flavour	7.43^{a}±0.01	7.27^{b}±0.01	7.00^{c}±0.02	7.39^{a}±0.01	7.27±0.01
Texture	7.43^{a}±0.01	7.28^{ab}±0.01	6.89^{b}±0.03	7.39^{a}±0.01	7.24±0.07
Juiciness	7.43^{a}±0.02	7.30^{b}±0.01	7.13^{c}±0.02	7.42^{a}±0.01	7.32±0.01
Saltiness	7.28±0.07	7.24±0.04	7.19±0.04	7.22±0.06	7.23±0.03
Sourness	7.26^{b}±0.01	7.27^{b}±0.01	7.01^{c}±0.02	7.31^{a}±0.02	7.21±0.01
Overall acceptability	7.47^{a}±0.04	7.28^{b}±0.03	7.17^{c}±0.02	7.42^{a}±0.05	7.33±0.01

Overall means bearing different superscripts in a row (a, b, c, d) differ significantly (P<0.05)

Colour and textural parameters

The effects of different acidulantson colour and textural parameters of chicken meat pickle are presented in Table 3. Lightness (L*) and yellowness (b*) values of control were significantly higher, whereas redness (a*) values were significantly lower than treatments. Arganosa and Marriott (1989) also reported higher redness values in restructured steaks treated with different acids due to higher rate of conversion of myoglobin into metmyoglobin resulting into lower colour intensity of product. Shear force values of control were again significantly higher than treatments due to higher moisture retention capacity of organic acids that could be correlated to the findings of moisture and other proximate parameters in present study. Rao and Gault (1990) observed that changes in structural organization of myofibrillar proteins increased the water holding capacity of acid marinated meat and influenced the tenderness and juiciness of product.

Sensory evaluation

The effects of different acidulantson sensory scores of chicken meat pickle are presented in Table 4. The colour and appearance, flavour, texture, juiciness and overall acceptability score of control and LA were significantly higher than AC and CA, however there was no significant difference in saltiness scores between control and treatments. Papadopoulos *et al.* (1991) also reported significantly higher juiciness and texture scores of cooked been marinated with sodium lactate. Ziauddin *et al.* (1996) also observed significantly higher sensory scores of chicken marinated with lactic acid and ginger extract than marination with acetic acid and other spices. Sourness scores of LA were significantly higher than control and other treatments due to desirable sourness of product as also reported by sensory panellists. Desmond and Troy (2001) also reported that lactic acid had more beneficial effect to improve texture, flavour and overall acceptability of meat products in comparison to other organic acids. These results were also supported by Khade *et al.* (2019) who found that the sensory scores of 0.5% citric acid incorporated chicken pickle were significantly lower than 1% acetic acid or 0.5% lactic acid incorporated pickle.

In present study, all sensory scores of LA were significantly higher than AC and CA. Therefore, LA-chicken pickle incorporated with 1% lactic acid was selected as the best treatment.

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