SENSORY QUALITY OF VACUUM-PACKED CURED-SMOKED CHICKEN FILLETS AS INFLUENCED BY *Capsicum annuum* EXTRACT

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Abstract
This study evaluated the effect of red pepper (*Capsicum annuum*) extract on sensory quality of vacuum-packed cured-smoked chicken fillets from improved indigenous meat-type chickens over a 60-day storage at room temperature. Experimental treatments had batches of chicken fillets cured with brine solution containing 0.015% nitrite (T1-positive control), no nitrite/extract (T2-negative control), 0.15% (T3), 0.30 %(T4), 0.45 % (T5), 0.60 % (T6) and 0.75 % (T7) capsicum extract. Sensory evaluation on day 0 and quality assessment over storage was carried out using a 9-point hedonic scale and a 3-point descriptive scale, respectively. Data were analysed using two-way ANOVA ($p<0.05$).
Significant ($p<0.05$) effect of treatments were observed in colour, flavour tenderness and overall acceptability (OA) for sensory evaluation on day 0 only. Highest values for colour (5.30) and flavour (5.25) were recorded for T3 and T5, respectively while T7 had highest values for tenderness (6.20) and OA (7.50). For quality changes over storage, rate of slime formation and colour change were significantly affected by treatments while visible microbial growth, odour, muscular elasticity and overall quality were not ($p<0.05$) affected. Duration of storage, however had ($p<0.05$) effect on all parameters measured. No slime formation was observed on day 0 for most treatments up to day 60, darker brown colour was observed as storage days progressed, on-set of off-odour at day 45 (2.39) and softer fillets with average muscular return up to day 60 (2.54). Overall quality reduced from excellent (3.00) on day 0 to acceptable/unacceptable (range of 1.3 to 2.1) for all treatments on day 60.
Inclusion of *Capsicum annuum* extract and duration of storage influenced the sensory quality of vacuum-packed cured-smoked chicken fillets to varying degrees. Overall quality of fillets during shelf storage was assessed as acceptable up to day 30 of storage.

Key words: sensory quality, *capsicum annuum* extract, vacuum packaging, shelf storage, chicken fillets
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Introduction

Developing countries like Nigeria are constantly faced with inconsistent power supply which exposes meat and meat products to temperature abuses during refrigerated and frozen storage. Also, increased concern about the relationship between processed meat products and non-communicable diseases has increased demand for healthy products, relevant researches relating to identification of alternatives and motivation of the meat industry to engage in reformulation strategies (Kraus, 2015; Yang *et al.*, 2015). Some of the most relevant trends regarding product reformulation are replacement of artificial additives/preservatives by natural alternatives, salt reduction and the addition of ingredients with potential positive effects on health (Jiang and Xiong, 2016; Perry and Grace, 2015; Strijbos *et al*., 2016; Valenzuela and Pérez, 2016). Red peppers are rich sources of phenolic compounds, carotenoids, ascorbic acid, and Vitamin A (Davis *et al*., 2007), giving rise to their preservative potential (Jimenez *et al.*, 2003). Developing meat products, using spices such as red peppers which have natural preservatives, and vacuum-packaging can extend their shelf life and ensure continuous supply of wholesome products to consumers.
Sensory analysis, as one of the tools for quality control in meat product development allows for effective quality and acceptability assessment over a storage period. It is an evaluation process used to measure, analyse and interpret human responses to food products. Perception occurs through the senses of touch, taste, sight, smell and sound (Meilgaard *et al*., 1999). Sensory evaluation allows for understanding of consumers' reactions to a new or existing product. It is important to measure the sensory characteristics of a new or modified product since consumers' acceptance is driven mainly by the quality of the product

(Chapman *et al*., 2001). This study was therefore carried out to determine the preservative effect of red pepper (*Capsicum annuum*) extract on sensory quality of vacuum-packed cured-smoked chicken fillets during storage.

Materials and methods

This study was carried out at the Animal Products and Processing Laboratory of the Department of Animal Science, University of Ibadan.

Test ingredient (Red pepper extract or oleoresin) was obtained by drying matured *Capsicum annuum* fruits until crispy. Dried red pepper fruits were thereafter ground and extracted using methanol at a ratio of 5ml methanol:1g of dried red pepper. Extract was thereafter concentrated and kept in the dark until further usage.

Fifteen (15) kg de-boned chicken meat obtained from matured improved indigenous meat-type chickens (*Funaab-α II*) was equally divided and submerged in curing solution containing 0.015% nitrite (T1-positive control), no nitrite/extract (T2-negative control), 0.15 % (T3), 0.30 % (T4), 0.45% (T5), 0.60% (T6) and 0.75% (T7) capsicum extract. Curing was done for 36-48h at 4^{o}C. After the curing period, cured chicken meat (according to treatments) were transferred into a smoking chamber for 2-2.30hrs at 60-80^{o}C for hot-smoking and subsequently cooled and sliced. Cured-smoked chicken fillets were vacuum-packed, labelled and stored for 60 days at room temperature. Sensory evaluation and quality assessment was carried out on stored vacuum-packed fillets on day 0, 15, 30, 45 and 60 of storage.

Sensory evaluation

Two distinct sensory evaluation procedures were carried out on prepared cured-smoked chicken fillets. Firstly, freshly prepared cured-smoked chicken fillets samples were assessed by a twenty-member semi-trained sensory panellists using a 9-point hedonic scale (Cross *et al*., 1978) on day 0 (zero) only. Panellists assessed randomly coded fillet samples for colour (1 = extremely dark/red; 9 = extremely light/pale), flavour-smoky (1 = not perceptible 9 = extremely intense), hotness (1 = extremely hot; 9 = extremely mild), tenderness (1 = extremely tough; 9 = extremely tender), juiciness (1 = extremely dry; 9 = extremely juicy) and overall acceptability (1 = dislike extremely; 9 = like extremely). Evaluation was carried out in a naturally illuminated/well-ventilated laboratory and panellists were offered crackers and clean water between samples to cleanse their palates.

Secondly, a ten-member trained panellists evaluated cured-smoked chicken fillet samples for different sensory quality attributes using a 3-point descriptive scale (Octavian and Octavian, 2010), vis external quality attributes - slime formation (3 = without slime; 1 = slime on all surfaces) and microbial growth (3 = not visible; 1 = visible on all surfaces), odour (3 = normal/characteristic; 1 = foreign/rancid/putrid), colour (3 = pink to light red; 1 = dark brown), muscular elasticity (3 = fast return; 1 = no return) and overall quality (3 = excellent; 1 = unacceptable) on day 0, 15, 30, 45 and 60 of storage.

Experimental design and statistical analysis

Experimental design was a completely randomised design in a factorial arrangement. First sensory evaluation data were analysed using one-way ANOVA (curing treatments effect only) while the second sensory evaluation data were analysed using two-way ANOVA (curing treatments and storage day effects) procedure of SAS v9.2 (SAS, 2012) at 5% significance level. Significant means were separated using Duncan Multiple Range Test of the same software.

Results and discussion

Sensory evaluation of freshly prepared cured-smoked chicken fillets (Table 1) shows significant ($p<0.05$) effect of treatment on colour, flavour, tenderness and overall acceptability of fillets. No significant ($p>0.05$) effect of treatment was however observed in hotness and juiciness values of the freshly prepared cured-smoked chicken fillets. Colour and flavour values ranged from 3.05 (moderately dark) and 3.75 (slightly perceptible) in treatment 2 to 5.30 and 5.25 (intermediate belt) for treatment 3 and 5, respectively.

Table 1: Sensory evaluation of freshly prepared cured-smoked chicken fillets

Parameters (%)	1	2	3	4	5	6	7	SEM
Colour	3.55^{bc}	3.05^{c}	5.30^{a}	3.60^{bc}	5.10^{a}	3.90^{bc}	4.70^{ab}	0.19
Flavour	4.40^{ab}	3.75^{b}	4.70^{ab}	5.05^{a}	5.25^{a}	5.00^{ab}	4.80^{ab}	0.15
Hotness	7.35	6.65	6.75	7.05	6.90	6.60	7.35	0.17
Tenderness	5.70^{ab}	6.00^{ab}	5.50^{ab}	4.80^{b}	5.90^{ab}	5.40^{ab}	6.20^{a}	0.60
Juiciness	4.90	5.40	4.80	4.85	5.10	4.95	5.35	0.16
Overall acceptability	6.30^{b}	7.20^{ab}	6.85^{ab}	6.70^{ab}	6.95^{ab}	7.20^{ab}	7.50^{ab}	0.11

$^{a,b,c\cdots}$-means along same row with different superscripts are significantly ($p<0.05$) different; SEM-Standard Error of Mean

1 - Nitrite; 2 - 0% nitrite/capsicum extract; 3 - 0.15% capsicum extract; 4 - 0.30% capsicum extract; 5 - 0.45% capsicum extract; 6 - 0.60% capsicum extract; 7 - 0.75% capsicum extract

Fillets in T7 were toughest (6.20) while T4 had the least tender score (4.80). Overall acceptability was highest (7.50) for treatment 7 and least (6.30) for treatment 1.

Sensory quality assessment of cured-smoked chicken fillets over storage presented in table 2 shows significant ($p<0.05$) effect of treatments on rate of slime formation and colour of chicken fillets while no significant ($p>0.05$) effect was observed in rate of visible microbial growth, odour, muscular elasticity and overall quality of fillets. Significant ($p<0.05$) effect of storage day was however observed for all parameters measured. Interaction effect of treatments and storage days was observed for slime formation, colour and muscular elasticity. Values for parameters measured were highest (3.00) on day 0 for all treatments and gradually decreased in time. No slime formation was observed on day 0 for most treatments up to day 60 (ranged from 3.00 on day 0 to 2.40 on day 60), darker brown colour was observed as storage days progressed, on-set of off-odour at day 45 (2.39) and softer fillets with average muscular return up to day 60 (2.54). Overall quality reduced from excellent (3.00) on day 0 to acceptable/unacceptable (range of 1.3 to 2.1) for all treatments on day 60.

Decrease in sensory quality could be as a result of development of slime and onset of microbial growth leading to increased off odours and fillets with slow muscular elasticity. The muscular elasticity assesses the period of muscular return to quantify the quality of meat. This is done by lightly pressing the fillets with the forefinger. Colour of fillets from all treatments rapidly dropped from 3.00 (pink to light red) to 1.49 (dark brown) over storage, although T1 (nitrite only) had recorded highest colour rating (2.24) followed by T5 (2.08) and T4 (2.04). Overall quality of chicken fillets was reported by panellists to be between excellent and acceptable on day 15 (2.07) and 30 (2.29) while it was between acceptable and unacceptable by day 45 (1.84) and 60 (1.70). The findings of this study agrees with reports by Deepshikha *et al.* (2016) who observed decreased ratings of colour and other sensory quality parameters in stored vacuum-packed smoked pork product cured in different curing solutions. Colour ratings observed during the storage period do not however agree with results reported by Lachamliani *et al.* (2015) in *Vawksa rep* (smoked pork product) meat samples. It also contradicts the statement by Parra *et al.* (2012) who stated that under vacuum packaging conditions, meat is protected from colour fading due to the low level of oxygen.

Table 2: Sensory quality assessment of cured-smoked chicken fillets over storage

	Slime Formation	Microbial Growth	Odour	Colour	Muscular Elasticity	Overall Quality
Treatments						
1	2.60^{b}	2.86	2.42	2.24^{a}	2.50	2.10
2	2.58^{b}	2.92	2.60	1.79^{b}	2.50	2.16
3	2.90^{a}	2.94	2.56	1.90^{b}	2.52	2.26
4	2.22^{c}	2.78	2.44	2.08^{ab}	2.44	2.06
5	2.64^{ab}	2.76	2.50	2.04^{ab}	2.55	2.16
6	2.70^{ab}	2.84	2.42	1.90^{b}	2.52	2.26
7	2.66^{ab}	2.86	2.58	1.90^{b}	2.66	2.26

SEM	0.07	0.05	0.08	0.07	0.08	0.08
Storage Day						
0	3.00^{a}	3.00^{a}	3.00^{a}	3.00^{a}	3.00^{a}	3.00^{a}
15	2.46^{bc}	2.96^{ab}	2.44^{bc}	1.91^{b}	2.59^{b}	2.07^{bc}
30	2.67^{b}	2.87^{ab}	2.49^{b}	1.60^{c}	2.21^{c}	2.29^{b}
45	2.54^{bc}	2.81^{b}	2.39^{bc}	1.86^{b}	2.27^{c}	1.84^{cd}
60	2.40^{c}	2.63^{c}	2.20^{c}	1.49^{c}	2.54^{b}	1.70^{d}
SEM	0.06	0.05	0.07	0.06	0.07	0.06
P-value						
Treatments	<0.0001	0.1754	0.5180	0.0003	0.6887	0.3077
Storage day	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Treatment*SD	<0.0001	0.0626	0.0518	0.0086	0.0438	0.1172

$^{a,b,c\cdots}$-means along same column with different superscripts are significantly ($p<0.05$) different; SD-storage day; SEM- Standard Error of Mean
1 - Nitrite; 2 - 0% nitrite/capsicum extract; 3 - 0.15% capsicum extract; 4 - 0.30% capsicum extract; 5 - 0.45% capsicum extract; 6 - 0.60% capsicum extract; 7 - 0.75% capsicum extract

Conclusion

Capsicum annuum extract inclusion in curing solution influenced the sensory quality of fresh and stored vacuum-packed cured-smoked chicken fillets to varying degrees. Highest overall acceptability was observed for chicken fillets in treatment 7 which had highest inclusion level of the extract. Overall quality of fillets during shelf storage was assessed as acceptable up to day 30 of storage. Also, it was observed that most sensitive attributes for panellists during the period of assessment was colour and overall quality.

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