ORGANOLEPTIC PROPERTIES OF MINCED BROILER CHICKEN MEAT PRESERVED WITH BLACK SEED (*Nigella sativa*) POWDER

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ABSTRACT
The aim of this study was to evaluate the effect of black seed (Nigella sativa) powder on organoleptic properties of meat when used as a natural preservative during refrigeration storage. Ten broiler chickens of 2.5kg each average weight were humanely slaughtered, deboned, and minced which was separated into four equal parts unto which 2%, 4% black seed powder (BSP), 0.15% butylated hydroxyltoluene (BHT) was added and negative control with no addition of any ingredient stored at 4^0C for 12 days. The experimental design was a 4x4 factorial (treatments and storage days) with replicates in completely randomized design (CRD). Sensory qualities were evaluated at four days intervals (0, 4, 8 and 12 days) and data collected were subjected to analysis of variance using a general linear model of SAS package and mean differences were separated using Duncan Multiple Range Test. The BSP treatments were significantly ($p<0.05$) ranked lower for colour, tenderness and juiciness while the BHT was significantly ($p<0.05$) ranked highest for overall acceptability. It was concluded that black seed powder had negative impacts on sensory properties of meat except aroma when applied at high doses (2% and 4%).
Keywords: Black seed powder, Broiler meat, Natural preservative, Sensory properties, Meat preservation

INTRODUCTION

Meat plays an important role in the human diet because it provides high-quality and readily digestible protein with all essential amino acids, and other essential micronutrients which are needed for optimal growth, cell functioning and sound health (Mourouti *et al*., 2015). The Nigerian poultry industry has been rapidly expanding in recent years with broiler production at the peak and is therefore one of the most commercialized (capitalized) subsectors of Nigerian agriculture (Adene and Oguntade, 2006; USDA, 2014) with a production of 300,000 tonnes of poultry meat in 2013 (FAOSTAT, 2017). Broiler meat is highly valued in Nigeria as its demand keeps rising every day. However, broiler meat is subject to chemical and microbial deterioration (Lodikas and Lougoyos, 1990) resulting in undesirable alterations such as discolouration, changes in texture, the emergence of off-flavors and odours, diminished nutritional quality, reduce shelf life, and the creation of secondary compounds that may pose risks to human health (Falowo, *et al*., 2014) and subsequently lead to substantial economic loss (Dave and Ghaly, 2011)

Therefore, it's important to reduce the level of meat spoilage, especially during processing and storage to meet the growing demand, provide wholesome meat and ensure food security. Black seed (*Nigella sativa*) have been reported to possess antibacterial, antifungal and antioxidant activities (Khoddami *et al*., 2011) thus, suitable as preservative.

MATERIALS AND METHODS

Black Seed Sourcing and Extraction

Black seed were sourced from Gurumi market, Kano State, Nigeria. The seed were sorted for extraneous materials and then air-dried for another 48 hours. The seed were then ground using a mortar and pestle, the ground seed were air-dried for another 48 hours before sieving through 1.18mm sieve to obtain seed powder.

Meat Source and Preparation

Broiler chickens of 2.5 to 3kg were purchased from Animal Science Department teaching and research farm, Ahmadu Bello University, Zaria. The birds were slaughtered, dressed then manually deboned on a stainless slab and the meat were mechanically minced together using a mincing machine (Tallers Ramon Model p-22, Barcelona, Spain).

Experimental Design and Treatments

The minced broiler chicken meat was divided into four equal parts portions. Each portion was independently treated as follows: Treatment 1: the negative control with no addition of any test ingredient. Treatment 2: the positive control with the addition of 0.15g/kg BHT (butylated hydroxyltoluene). Treatment 3: black seed powder 2% (BSP 2%) and Treatment 4: black seed powder 4% (BSP 4%).

The experimental design was a 4x4 factorial with three replicates in completely randomized design (CRD) which implies four (4) test ingredients (i) Black seed powder (BSP) 2%, (ii) Black seed powder (BSP) 4%, (iii) 0% (negative control i.e no addition) and (iv) BHT 0.15% (positive control) and four (4) storage days: 0, 4, 8 and 12 day.

Meat Sample Storage

The meat was packed in zip-lock nylons labelled with corresponding treatments (Control, BHT, BSP2% and BSP4%) and test days (0, 4, 8 and 12). The Minced and treated meat were stored in a refrigerator (4±1ºC) for 12 days.

Cooking of Meat Samples for Sensory Evaluation

The cooking was done following the boiling method described by Abdel-Naeem *et al*. (2017) with modification such that the time of cook was reduced from 30 minutes to ten minutes. The water was initially heated to a temperature of 100°C in a stainless pot after which molded minced meat samples were submerged in the water and heated for another ten minutes.

Sensory Evaluation

A total of 50 semi-trained individual panelists were engaged to evaluate and score the meat samples for colour, texture, flavor, juiciness, tenderness and overall acceptability of different treated meat which were served in coded random order of presentation to eliminate bias. This was conducted using 9 points Hedonic scale and the scale was rated: 1) Dislike extremely, 2) Dislike very much, 3) Dislike moderately, 4) Dislike slightly, 5) Neither like nor dislike, 6) Likely slightly, 7) Like moderately, 8) Like very much, 9) Like extremely.

Data Analysis

Data obtained for black seed powder and extract effects on lipid oxidation, microbiological and sensory properties of minced broiler chicken meat were subjected to analysis of variance (ANOVA) using the general linear model of SAS software (SAS, 2005). Significant difference among treatments means was separated at $P< 0.05$ using the Duncan Multiple Range Test.

RESULT AND DISCUSSION

The significant lower rank of the 2% BSP and 4% BSP compared to other treatments in terms of meat colour means that the level of BSP used in the study changed the meat colour significantly which can be attributed to the colour of the black seed powder. However, there was no significant difference between the colour of the control and BHT treatments, indicating that the addition of BHT did not affect meat colour significantly. In terms of tenderness and juiciness, 2% BSP and 4% BSP were ranked lower compared with the control and BHT which may be as a result of the seed powder absorbing the available moisture in the meat.

The overall acceptability showed a significant difference across the treatments, with the BHT treatment being the most accepted and ranked the best, followed by the control and then the BSP treatments. This could be attributed to colour change caused by BSP. Apparently, consumers make purchasing decision based on the meat appearance (Carpenter *et al*, 2001). This result contrast previous result of Demir and Agaoglu (2021) who reported that addition of artichoke (*Cynara scolymus*) powder extracts to minced meat increased the overall acceptability. Regarding storage period, meat flavour and tenderness showed no significant difference except on day 12, which means that the meat started to deteriorate (rancid) after 8 days of storage. Meat juiciness, on the other hand, reduced as the storage period increased which could be attributed to water loss during storage.

The observed colour ranking with the control treatment having the highest and 4% BSP having the lowest ranking may be attributed to the black taint colour given by the black seed.The 4% BSP ranked highest for flavour, followed by the control and 2% BSP. The 4% BSP is likely to have had more flavour intensity because black seed is considered both spice and herb seed which was traditionally used as seasoning in food. Dubey *et al*. (2016) suggested that black seed should be stored in air-tight packages due to its high flavour and aroma. The high ranking

of the control may be due to the presence of natural chicken flavor or due to the absence of any additives.The low ranking recorded for BSP 2% and 4% in term of tenderness and juiciness may be attributed to the high concentration of BSP used in this study which may have absorbed the available moisture. The overall acceptability result indicates that the BHT treatment was most acceptable on the last day of the trial (day 12). This may be due to the fact that BHT as strong antioxidant helped to preserve the meat's quality over time, thus maintaining its overall acceptability

Interaction effect of treatments and storage period (day) on sensory properties of broiler chicken meat

Parameters	Day	Colour	Flavour	Tenderness	Juiciness	Overall acceptability
Control	0	7.60^{a}	6.70^{abc}	6.95^{ab}	7.65^{a}	6.70^{b}
	4	7.80^{a}	6.65^{abc}	7.30^{a}	7.50^{a}	6.90^{b}
	8	7.50^{ab}	6.50^{bc}	6.85^{ab}	7.90^{a}	7.30^{a}
	12	7.20^{bcd}	4.80^{d}	6.05^{c}	5.15^{efg}	5.75^{d}
BSP 2%	0	2.95^{f}	6.70^{abc}	5.50^{d}	6.75^{b}	5.40^{d}
	4	3.75^{e}	6.70^{abc}	4.75^{e}	5.65^{de}	4.85^{e}
	8	2.90^{f}	6.30^{c}	5.65^{cd}	6.05^{cd}	3.30^{f}
	12	3.85^{e}	4.70^{d}	3.95^{f}	4.40^{hi}	6.40^{c}
BSP 4%	0	2.40^{g}	7.10^{a}	6.05^{c}	6.25^{bc}	6.40^{c}
	4	3.20^{f}	7.15^{a}	4.90^{e}	5.05^{fg}	5.75^{d}
	8	2.40^{g}	7.20^{a}	6.00^{cd}	5.50^{ef}	5.70^{d}
	12	3.00^{f}	4.55^{d}	4.60^{e}	3.95^{i}	4.30^{e}
BHT	0	7.45^{abc}	6.95^{ab}	7.15^{ab}	7.55^{a}	7.80^{a}
	4	7.50^{ab}	6.50^{bc}	6.75^{b}	6.60^{b}	4.70^{e}
	8	7.10^{cd}	6.90^{ab}	7.05^{ab}	7.45^{a}	7.05^{b}
	12	6.90^{d}	4.30^{d}	5.65^{cd}	4.90^{gh}	7.55^{a}
SEM		0.18	0.29	0.26	0.26	0.29

$^{abcd:}$ means with different superscripts along the same column differed significantly at $p>0.05$. BSP= black seed powder, BHT= butylated hydroxytoluene, SEM= standard error of mean

CONCLUSION

The research results showed that inclusion of high doses (2% and 4%) of black seed (*Nigella sativa*) as meat preservative had negative impacts on most organoleptic attributes of broiler meat thus the smaller concentrations should be investigated.

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