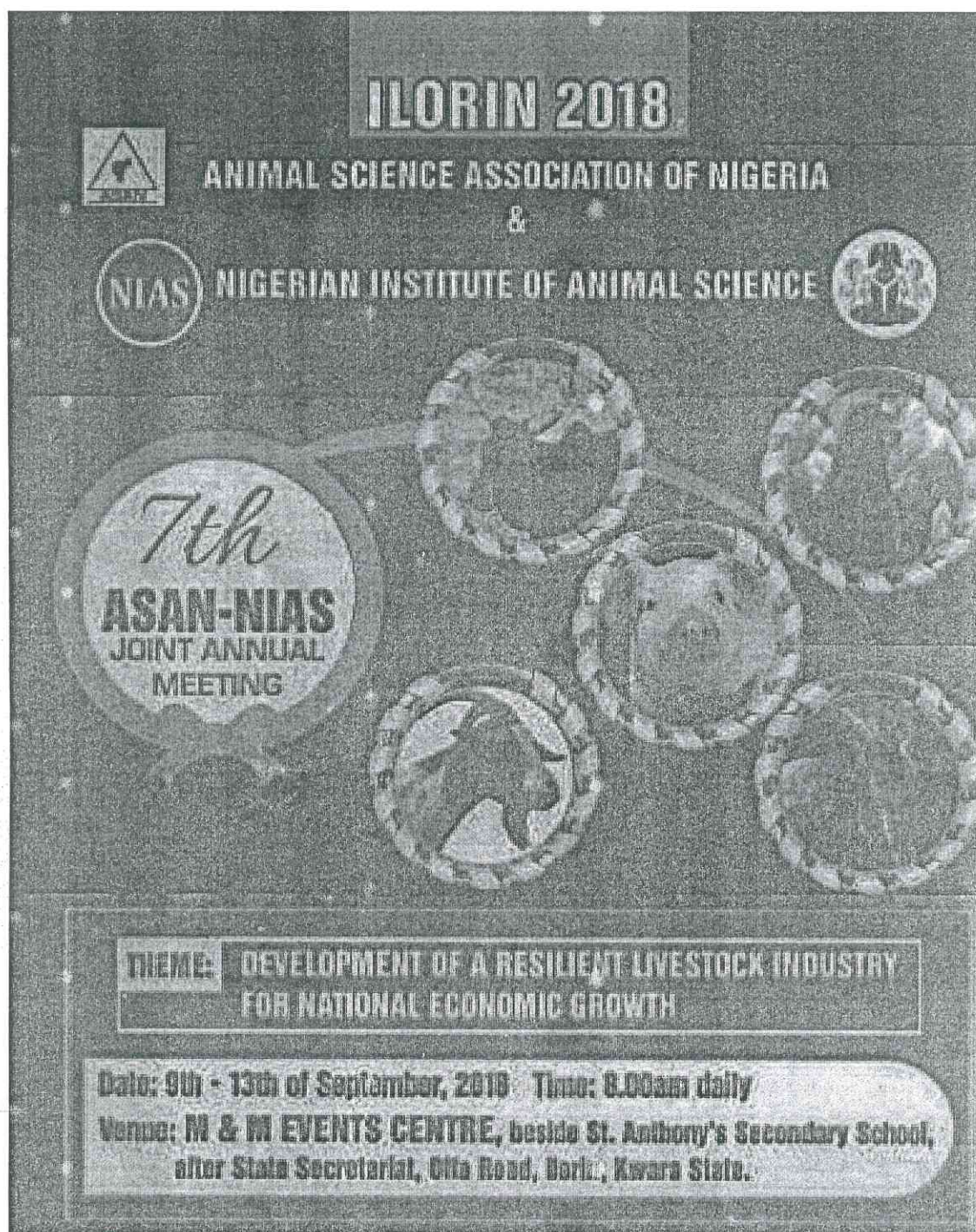




BOOK OF PROCEEDINGS

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Effect of Storage Condition on Chemical Properties of Japanese Quail and Chicken Eggs

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Abstract: The study was conducted to determine the effect of storage condition on protein and lipid oxidation in chicken and Japanese quail's eggs. A total of 192 freshly laid chicken and quail table eggs (96 per species) were obtained and stored at two different temperatures; ambient temperature (27.9°C – 30.1°C) and refrigerator (4°C). Data were obtained on protein oxidation and lipid oxidation by measuring the carbonyl value and the thiobarbituric acid reactive substance (TBARS) value respectively in the eggs of the two species. The chicken eggs had a significantly higher TBARS value. The carbonyl content of the eggs also increased with length of storage period but values were not significantly different in the two species. Storage conditions had effect on the rate of deterioration in the two species with eggs in the refrigerator having significantly lower ($p < 0.05$) content of the carbonyl and TBARS value than those in room temperature. In either storage conditions, quail eggs had significantly lower ($p < 0.05$) values of lipid and protein oxidation than the chicken eggs and hence better oxidative stability and shelf life.

Keywords: Carbonyl content, Storage condition, Storage period, TBARS.

DESCRIPTION OF THE PROBLEM

Eggs are important source of high quality lipid and proteins, vitamins and mineral (1). Eggs are readily susceptible to spoilage, which can be influenced by storage conditions. Changes in yolk and albumen occur during storage of eggs, initiating hydrolytic process of protein degradation and lipid degradation (2). Few studies have examined the impact of storage conditions on the physical properties of quail eggs (3) and chicken eggs (4). However, there is a dearth of information on the changes in oxidative stability of chicken eggs and quail eggs in response to storage conditions. Moreover, there is the need to further substantiate the claim that quail eggs are superior to chicken eggs in terms of quality and shelf life. Therefore, the present study has been undertaken to determine the effects of storage condition and storage period on some chemical characteristics of chicken and Japanese quail eggs.

MATERIALS AND METHODS

One hundred and ninety-two freshly laid table eggs (96 per specie) of both chicken and Japanese quail eggs were collected from a reputable commercial farm in Ilorin, Kwara state and immediately taken to the laboratory for analysis.

Eggs of each species were marked and divided into two equal groups; one part was stored in refrigerator at 4°C while the other part was stored in ambient temperature (average temperature of 27.9°C to 30.0°C) at a relative humidity of 70%. Temperature was set at 4°C at regular power supply. Eggs in each group were further divided into eight parts of six eggs/ replicate. Measurements of egg qualities were taken periodically from day 0 at seven days interval for a total duration of 49 days. The Thiobarbituric acid TBARS values were determined for the Malonaldehyde (MDA) formed in fresh eggs and those that were refrigerated and was measured according to the TBA method described by (5) using third derivative spectrophotometry. Egg protein carbonyl content were measured according to the method described by (6). The reaction between 2,4-dinitrophenyl hydrazine (DNPH) with Protein Carbonyl to form hydrazone. Carbonyl contents were determined from the absorbance at 370 nm using a molar absorption coefficient of 22,000 M⁻¹ cm⁻¹ (6). The results were expressed as µmole of protein carbonyl content per gram of protein (µmole PC/g protein).

Statistical Analysis: Data collected were subjected to analysis of variance using a 2 x 2 x 8 factorial model in a completely randomized design (CRD) using the general linear procedure of SAS (2012). Significant differences between means were separated using the Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Table 1: Effects of Species, Storage Condition and Period on the TBARS and Carbonyl Content of Chicken and Quail Eggs

Factor		TBARS ($\mu\text{mol}/100\text{g}$)	CARBONYL ($\mu\text{molcarbonyl}/\text{mg protein}$)
Species	Chicken	9.7935 ^a	5.63e-05
	Quail	5.8494 ^b	5.74e-05
	SEM	0.16	0.00001
	P value	0.0001	0.54
Storage condition	Ambient	9.7828 ^a	6.337e-5 ^a
	Refrigerator	5.8601 ^b	5.036e-5 ^b
	SEM	0.16	1.2e-6
	P value	0.0001	0.0001
Period (Days)	0	0.15 ^f	2.74e-5 ^d
	7	1.197 ^f	3.04e-5 ^d
	14	4.10 ^e	5.18e-5 ^c
	21	4.21 ^e	6.36e-5 ^b
	28	7.5245 ^d	6.40e-5 ^b
	35	11.8281 ^c	6.97e-5 ^{ab}
	42	14.8049 ^b	7.04 ^{ab}
	49	18.7677 ^a	7.76e-5 ^a
	SEM	0.1	0.0001
	P value	0.0001	0.0001
Species x condition		**	Ns
Species x period (days)		***	***
Period (days) x condition		***	***
Condition x species x period (days)		**	***

a-f Means in the same section and the same column having different superscript differs significantly.

Table 2: Details of Interaction between Storage condition and Storage period on TBARS and Carbonyl content on Chicken and Japanese quail Eggs

Day	Species	Storage condition (Temperature)	TBARS ($\mu\text{mol}/100\text{g}$)	Carbonyl (m mol carbonyl/mg) protein
0	Chicken	Refrigerator	0.15 ^l $\pm$ 0	2.97e-05 ^{hkij} $\pm$ 6.65e-06
		Ambient	0.15 ^l $\pm$ 0	2.97e-05 ^{hkij} $\pm$ 6.65e-06
	Quail	Refrigerator	0.15 ^l $\pm$ 0	2.51e-05 ^k $\pm$ 2.04e-06
		Ambient	0.15 ^l $\pm$ 0	2.51e-05 ^k $\pm$ 2.04e-06
7	Chicken	Refrigerator	0.85 ^{lk} $\pm$ 0.44	2.95e-05 ^{kij} $\pm$ 1.70e-07
		Ambient	1.68 ^{lk} $\pm$ 0.33	3.87e-05 ^{hkgijf} $\pm$ 9.47e-06
	Quail	Refrigerator	0.66 ^{lk} $\pm$ 0.23	2.46e-05 ^k $\pm$ 5.60e-07
		Ambient	1.57 ^{lk} $\pm$ 0.26	2.86e-05 ^{kj} $\pm$ 5.60e-07
14	Chicken	Refrigerator	2.06 ^{lkj} $\pm$ 0.5	3.76e-05 ^{hkgij} $\pm$ 5.03e-06
		Ambient	11.15 ^{ef} $\pm$ 1.19	7.47e-05 ^{bdac} $\pm$ 2.15e-06
	Quail	Refrigerator	0.93 ^{lk} $\pm$ 0.07	3.66e-05 ^{hkgij} $\pm$ 5.14e-06
		Ambient	2.25 ^{lkj} $\pm$ 0.15	5.84e-05 ^{ebdgcj} $\pm$ 8.78e-06
21	Chicken	Refrigerator	5.5 ^{hj} $\pm$ 0.5	5.35e-05 ^{ehdgijf} $\pm$ 9.71e-06
		Ambient	15.26 ^{dce} $\pm$ 0.99	7.79e-05 ^{bdac} $\pm$ 1.22e-06
	Quail	Refrigerator	3.05 ^{ilkj} $\pm$ 0.84	4.58e-05 ^{ehkgijf} $\pm$ 5.44e-06

		Ambient	6.29 ^h ± 0.68	7.88e-05 ^{bdac} ± 6.00e-08
28	Chicken	Refrigerator	6.36 ^{ih} ± 0.3	8.06e-05 ^{bdac} ± 7.50e-07
		Ambient	15.26 ^{dce} ± 0.99	2.51e-05 ^k ± 2.04e-06
	Quail	Refrigerator	3.98 ^{ikj} ± 0.21	6.81e-05 ^{ebdac} ± 2.96e-06
		Ambient	6.36 ^h ± 0.3	8.06e-05 ^{bdac} ± 7.50e-07
35	Chicken	Refrigerator	10.74 ^{gf} ± 1.07	5.71e-05 ^{bdac} ± 1.16e-05
		Ambient	18.44 ^e ± 1.24	8.10e-05 ^{bdac} ± 9.76e-06
	Quail	Refrigerator	5.91 ^{ih} ± 1.21	5.66e-05 ^{ehdgicf} ± 1.36e-05
		Ambient	12.23 ^{fe} ± 0.69	8.42e-05 ^{bac} ± 3.86e-06
42	Chicken	Refrigerator	15.7 ^{dce} ± 1.78	5.77e-05 ^{edgcf} ± 7.96e-06
		Ambient	22.5 ^b ± 2.47	7.58e-05 ^{bdac} ± 5.75e-06
	Quail	Refrigerator	7.67 ^{gh} ± 0.4	6.22e-05 ^{ebdgf} ± 9.00e-06
		Ambient	13.35 ^{dfe} ± 1.34	8.59e-05 ^{ba} ± 1.31e-05
49	Chicken	Refrigerator	17.67 ^c ± 1.94	7.53e-05 ^{bdac} ± 2.52e-05
		Ambient	28.33 ^a ± 0.15	7.73e-05 ^{bdac} ± 1.53e-05
	Quail	Refrigerator	12.39 ^{fe} ± 3.28	6.57e-05 ^{ebdac} ± 1.25e-05
		Ambient	16.67 ^{dc} ± 1.75	9.22e-05 ^a ± 8.29e-06

^{a-l}Means in the same column having different superscript differs significantly

Table 1 shows the TBARS values and carbonyl content of chicken and quail eggs subjected to different storage conditions and storage period with the details of interactions in Table 2. Chicken eggs had a significantly higher ($p < 0.05$) TBARS value (9.7935) than quail eggs (5.8494). Eggs stored at ambient temperature had a significantly higher ($p < 0.05$) TBARS value (9.7828) than those stored in the refrigerator (5.8601) regardless of species and length of storage. TBARS value of eggs showed no significant ($p > 0.05$) increase between day zero and day seven. However, there was significant ($p < 0.05$) increase in the values from day seven onward regardless of specie and storage condition. This result agrees with (7) who stated that the TBARS values of eggs increased when eggs were stored for 30-90 days at 4°C. The author, explained lipid oxidation becoming more intensive due to a larger occurrence of unsaturated fatty acids, which are susceptible to oxidation.

Lipid oxidation increased in proportion to increase of MDA concentration in analyzed sample. Food appropriate for consumption should present lipid oxidation values below 3mg MDA/kg with an upper limit of 7-8mg mda/kg (8). These results were in accordance with results published by (9), who also pointed out that MDA increased in proportion to egg storage period. Intensity of lipid peroxidation in egg yolks indicate how fresh the egg is. Thus, the higher the MDA values, the more intense the rate of oxidation. Chicken eggs deteriorated faster than that of Japanese quail eggs in this experiment. This result support the work of (10) who showed that antioxidant activity of Japanese quail eggs is slightly higher ($p < 0.05$) when compared with hen eggs. This could be caused by the fact that quail eggs have a slightly higher proportion of proteins, minerals and vitamin A, which may cause higher antioxidant activity as indicated by (11).

The carbonyl content of chicken eggs werenot significantly different ($p > 0.05$) from that of quail egg. Eggs stored at ambient temperature however had significantly ($p < 0.05$) higher carbonyl content (6.337e-5 $\mu\text{molcarbonyl/mg}$) than those stored in the refrigerator (5.036e-5 $\mu\text{molcarbonyl/mg}$). Carbonyl content in both species also increased as storage period progressed though the values were not significantly different as from the 35th day of storage. The higher the carbonyl value, the higher the rate of deterioration in the eggs. The values for the carbonyl were however lower than that obtained by (12) who reported 87.42 $\mu\text{molcarbonyl/mg}$ protein and 122.3 $\mu\text{molcarbonyl/mg}$ protein for eggs in ambient temperature and refrigerator, respectively. However, this could be as a result of temperature differences, species differences and storage period.

CONCLUSION

From this study, it is shown that lipid and protein oxidation increased in both species as storage period lengthens. Irrespective of specie, rate of deterioration was lower in the refrigerator than in ambient temperature. Also, regardless of storage condition and period, chicken eggs deteriorated faster than Japanese quail eggs. It was therefore concluded that Japanese quail eggs had better shelf-life than chicken eggs.

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