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Varietal effect of citrus seed extracts on lipid oxidation of raw and cooked broiler meat

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ABSTRACT: The potential of extracts prepared from seeds of three citrus specie (orange, lemon and grape) to stabilize lipid oxidation of cooked and raw broiler meat under refrigeration storage was evaluated and compared with Butylated Hydroxyl Anisole (BHA). To a separate 350g of minced broiler meat, the citrus seed extracts were applied separately at the rate of 1.5%, a control without additive and 0.01% of BHA which serve as positive control. Each sample was divided into 28 parts of 12g each. Fourteen (14) of these were cooked in microwave oven for 1½ minutes while the other 14 parts were left raw. Both cooked and raw samples were stored in a refrigerator for 12 days. Oxidative stability of the cooked and raw samples was monitored at 2-day interval using the Thiobarbituric acid (TBA) test. The results shows that meat samples treated with lemon and grape seed extracts had lower TBARS values than the control and BHA treated samples. Treated raw meat samples have a lower TBARS values than the cooked meat samples. Addition of grape and lemon seed extract was effective in reducing lipid oxidation in both cooked and raw broiler meat under refrigeration.

Keywords: Citrus, Butylated Hydroxy Anisole (BHA), antioxidant, minced, broiler.

Introduction

The need to curb reduction in nutritional quality, incidence of off color, off odor and rancid taste or warmed over flavor caused by lipid oxidation necessitate the use of antioxidants in food (Olorunsanya *et al*, *2009*). There are two types of antioxidants on the basis of their source (Branen, 1975). These are synthetic and natural antioxidants (Branen, 1975, Kahl and Kappus, 1993). Synthetic antioxidants have been commonly used to suppress lipid oxidation in foods for a long period of time and are ascertain to be very effective (Branen, 1975, Kahl and kappus, 1993). Examples are Butylated hydroxyl anisole (BHA), Butylated hydroxyl toluene (BHT), Tertiary butylhydroxylquinone (TBHQ) etc (Gray *et al,1996*). However, despite the effectiveness of these chemicals, there some problems associated with there use (Cao *et al*, 1997). Synthetic antioxidants are very scarce, expensive and pose health hazards to consumers (Olorunsanya *et al,2009*). There is a concern about the safety and toxicity of synthetic antioxidants in relation to their metabolism and accumulation in the body organs and tissues (Cao *et al,*1997*).*

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Synthetic antioxidants are known among other things to cause impairment to blood clothing, lung damage and to act as tumor promoters (kahl & kappus,1993). As a result of these, consumers have preference for natural ingredients and there is a growing interest in the potential use of antioxidants from natural sources (Kingstone *et al, 1998*). The need to find alternative sources of antioxidants brought about the use of spices such as ginger, tomato, garlic etc (Lodikas and Lougovis, 1990). Phenolic extracts from herbs and spices(Abdallah and Roozen, 1999), cereals and legumes (Onyeneho & Hiettiarachchy, 1992) have been reported to retard lipid oxidation in oils and fatty foods.

Phenolic compounds exist considerably in citrus which triggered some scientific interest recently (Rapisarda *et al*, 1999). Vitamin C in citrus, at levels greater than 1000mg/kg ascorbic acid is an effective inhibitor of oxidation, whereas at low levels (<1000mg/kg), ascorbic acid has been shown to catalyze warmed over flavor (Wang *et al*,2007; Sato *et al*,1973). Flavonoids are widely distributed group of phenolic compounds presents in citrus fruits with health related benefits which are based on the antioxidant properties (Roberts and Gordon, 2003). Flavones, flavanols and flavonones are the flavonoids presents in citrus fruits (Roberts and Gordon, 2003). The objective of this study is to evaluate the effectiveness of citrus specie that are common in Nigerian markets in improving the shelf life of raw and cooked meat under refrigeration.

Materials and Methods

Collection of Samples

Ten broiler chickens of eight (8) weeks old were purchased from Animal Production Pavilion, Department of Animal production, Faculty of Agriculture, University of Ilorin. The citrus fruits were obtained from Ipata market within Ilorin metropolis.

Processing of Broiler Chickens

The broiler chickens were slaughtered by cutting through the jugular vein. They were scalded manually by dipping into boiling water for a minute, defeathered, washed, eviscerated and deskined. The carcass was cut into different parts. The neck, head, legs and wings were removed while the remaining parts were deboned using a sharp knife. Thereafter, the broiler meat was minced using a food processor (National MK-5080M).

Preparation of citrus seed extracts

Dried and finely ground seeds of the citrus fruits i.e lemon (*Citrus limonum*), orange (*Citrus sinensis*) and grape fruit (*Citrus paradisi*) were extracted individually with 100% methanol through soxhlet extractor.

Application of treatments

The minced meat was weighed into 5 different portions of 350g. The first portion serve as the negative control (no additive). The three citrus seed extracts were added to separate portion of minced meat at the rate of 1.5% of weight of the meat sample. 0.01% of BHA was added to a separate 350g meat sample and this serve as a positive control. Each of the treated minced meat was divided into twenty eight (28) parts of 12g each. Fourteen (14) of these were cooked for 1½ minutes using a microwave oven (National-NN-55WF) while the other parts were left raw. Both cooked and raw samples were wrapped in different foil paper with labeling corresponding to the applied treatments and stored in a refrigerator (HR-170T) for twelve (12) days. The oxidative stability was monitored at 2-day interval.

Determination of lipid oxidation

Lipid oxidation in the samples was evaluated using the 2-thiobarbituric acid (TBA) test. The Thiobarbituric acid reactive substance (TBARS) values were measured on a duplicate 10g samples at each storage day using the distillation method of Tarladgris *et al,* 1964. 10g of the meat sample was homogenized with 47.5ml of distilled water in a specimen bottle using glass pestle. The homogenized mixture was rinsed with 50ml of distilled water into

a round bottom flask. Thereafter, 2.5ml of Hydrochloric acid (1:2 solution) was added and the mixture was distilled through a condensing assembly to collect about 15ml of the distillate. 5ml of the distillate was mixed with 5ml of TBA (0.02M) and boiled for 35 minutes in a boiling water, then cooled for ten minutes with cold tap water for color development. The duplicate absorbance readings were measured at 538µ against a blank that contained 5ml of hydrochloric acid solution and 5ml of thiobarbituric acid (TBA) reagent using a spectrophotometer. The absorbance values were multiplied by a factor of 7.8 to obtain the Thiobarbituric acid reactive substance (TBARS) values in milligram per malonaladehyde per kilogram of sample.(mg/MDA/kg).Triplicate samples were analyzed in duplicate for each treatment.

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) using a 5*2*7 factorial design using a Genstat 5 program package (Payne, lane and Genstat committee, 1987). The difference between means were determined by Duncan multiple range test and significance was defined at $P<0.05$. Bar chart was used for the pictorial representation of the data obtained for the TBA analysis.

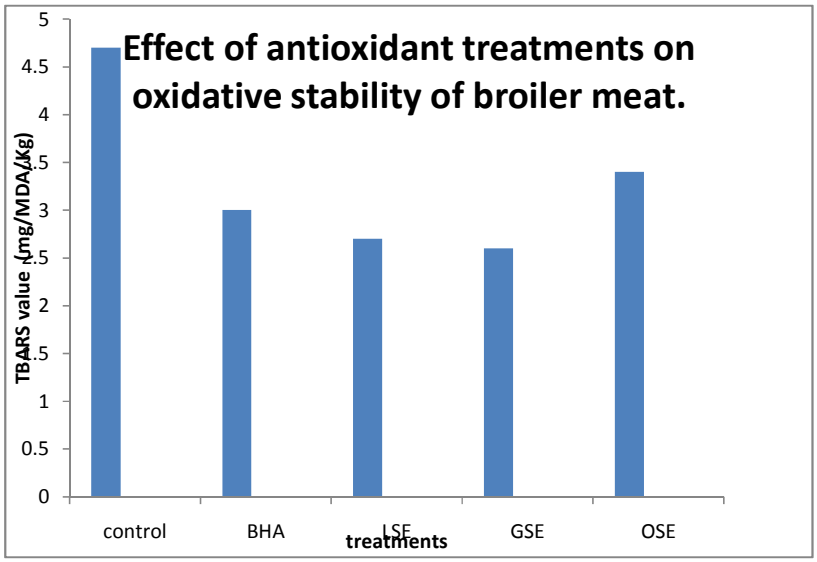
Results and Discussion

The minced meat treated with citrus seed extracts and BHA have lower TBARS value ($P<0.05$) than the control (Figure 1). However, the TBARS value of lemon and grape seed extracts are lower than BHA. This thus shows that lemon and grape seed extracts retard lipid oxidation in minced broiler meat better than the conventional BHA. This result is in line with the report given by Roberts and Gordon, (2003) that citrus by–products represents a rich source of naturally occurring flavonoids which possesses significant antioxidant properties.

The TBARS values in raw meat samples were less than that of the cooked samples (Figure 2).This result agrees with the general observations of oxidation in cooked meat (Asghar *et al*, 1988; Rhee, 1999; Cotelle *et al, 1996*). Cooking was reported to disrupt lipid membrane system causing an interaction of antioxidant such as oxygen and molecular weight metal with unsaturated fatty acids resulting in the generation of free radicals and propagation of oxidative reactions (Tim and Watts,1958, Asghar *et al*,1988). In the cooked meat samples, grape seed extracts had the lowest TBARS value. This is in line with the report given by Banon *et al* (2007) that grape seed extracts have better potential as a shelf life extending antioxidant in cooked meat systems. In raw meat samples, lemon seed extracts (LSE) had the lowest TBARS value of 2.26. Although, there is no significant difference between this value and the TBARS value of grape and orange seed extracts (OSE). All the citrus seed extracts performed better than BHA ($P<0.05$) in both raw and cooked meat samples.

Interactive effects of antioxidant treatments and storage days on the oxidative stability of broiler meat were shown in Figure 3. At storage day 0, 2, 4 and 6, BHA had a lower TBARS value than all other treatments. This agrees with the report of Branen, (1975) that BHA can significantly reduce lipid oxidation in fatty foods. At storage day 8, grape seed extract (GSE) had the lowest TBARS value. Although, this was not significantly different ($P>0.05$) from the value obtained with lemon seed extract (LSE). At storage day 10, there is a sharp reduction in TBARS value for all the treatment levels. This is unexpected because lipid oxidation has been reported to increase as storage days increases (Dawson and Schierhotz, 1976). At storage day 12, lemon seed extract had the lowest TBARS value.

There was an interaction between levels of antioxidant treatments and storage days on oxidative stability of broiler meat ($P<0.05$) (Figure 4). The TBARS values were observed to be different for cooked and raw meat samples at various storage days. At storage day 0, the TBARS values for all treatments for cooked and raw meat samples were low. However, lemon and orange seed extracts reduced lipid oxidation more ($P<0.05$) than other treatments in both cooked and raw samples. At storage day 2, BHA and grape seed extract had the lowest TBARS value in raw and cooked meat samples respectively.



Key

BHA-Butylated Hydroxyl Anisole

LSE -Lemon seed extract

GSE-Grape seed extract

OSE-Orange seed extract

Figure 1.

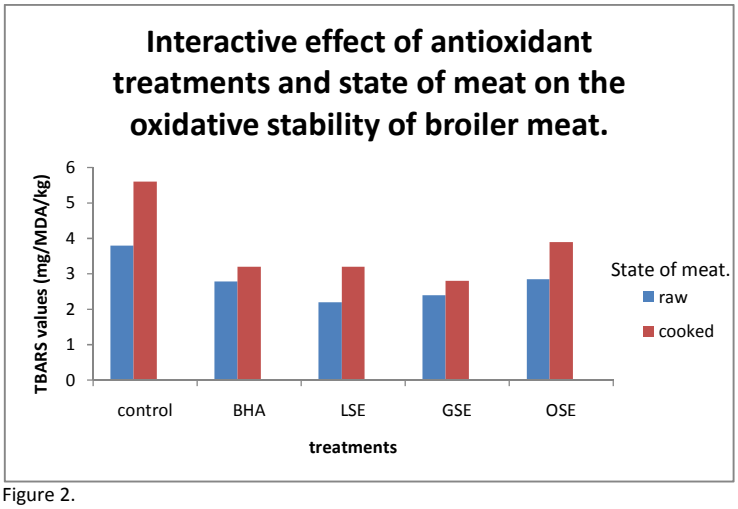


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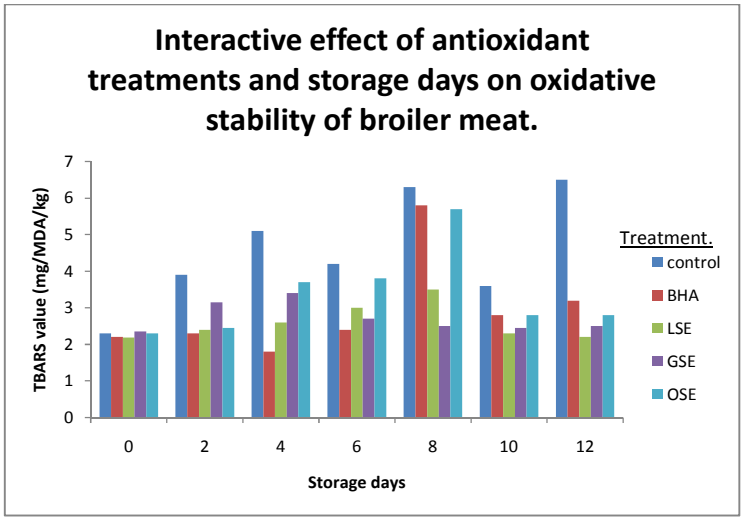
Figure 2.



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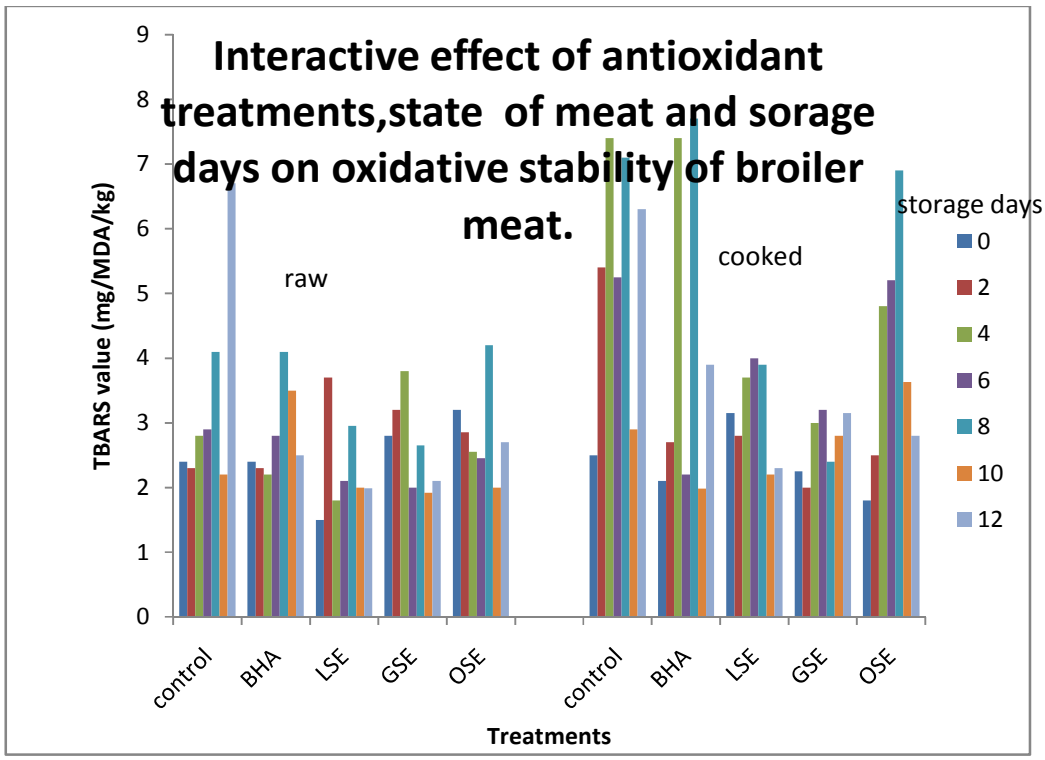

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Figure.4

In raw meat samples, at storage day 4, lemon seed extract had the lowest TBARS value of 1.76. At storage days 6 and 8, grape seed extract had the lowest TBARS values of 2.03 and 2.63 respectively. This clearly indicate the potential of citrus seed extracts as antioxidant. In the cooked meat samples, at storage day 4, grape seed extracts had a lower TBARS value ($P<0.05$) than all other treatments. BHA had the highest TBARS value of 7.37 as obtained for the TBARS value of control. The high TBARS value of BHA was unexpected and cannot be explained. This is because BHA has been reported not to loose it antioxidant properties during cooking.(Kirk-othner, 1979). At storage day 6, BHA reduces lipid oxidation more ($P<0.05$) while grape seed extract had the lowest TBARS value at storage day 8 and 10. At storage day 12, all treatments reduced lipid oxidation than the control. However, lemon seed extract had the lowest TBARS value indicating its' capacity to prevent or reduce lipid oxidation in meat.

Conclusion

Lemon and grape seed extracts were effective in lowering lipid oxidation in both cooked and raw meat samples than BHA. However, their antioxidative effect was more pronounced in raw meat samples than cooked meat samples. The cheap and relatively available lemon and grape seed extracts could therefore be a good source of antioxidants in meat thus extending the shelf life of broiler meat.

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