Study on Antioxidant and Antimicrobial Effect of Garlic (*Allium sativum*) in Garlic Incorporated Chicken Sausages

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Introduction

Meat is the most naturally occurring nutrient dense food stuff in the world (Kinsman *et al.*, 1994). With the theme of value addition, manufacturing sausage is one of the oldest forms of processed meat product with various additives (Raju *et al.*, 2003). Antioxidants are used in processed meat products with the aim of increasing the shelf life. The most common antioxidants used in food preservation are synthetic, such as butylatedhydroxytoluene (BHT), butylatedhydroxyanisole (BHA).With the reveal of adverse health effects of synthetic antioxidants by the researchers the food processors have focused to use natural substances which have antioxidant and antimicrobial effect (Ahmed *et al.*, 1986). Garlic (*Allium sativum)* is one of the most commonly used ingredients as a flavor enhancer for sausage. In addition to flavoring, garlic is appreciated for its medicinal properties. Allicin is the main biologically active component of fresh garlic that affect antioxidant activity (Ankri and Mirelman, 1999). This study was carried out to determine the suitable garlic form and concentration of garlic in chicken sausages to determine the antioxidant effect of garlic against lipid oxidation and antimicrobial effect.

Methodology

Control recipe for chicken sausage was prepared by conducting several preliminary trials using mincing chicken meat, salt, vegetable oil, rusk powder, spices and BHA, as an antioxidant. The ingredients were allocated according to the SLSI standards and followed the standard sausage producing procedure according to the Toldra (2010). The suitable BHA level was determined according to the regulations in toxics A to Z: A Guide to Everyday pollution hazards (2006). The amount of BHA used in the control sample was 0.1 g per 1 kg of meat. Furthermore, developing control sausage recipe from all the preliminary trials was by sensory evaluation using 32 untrained panelists.

The garlic was allocated according to the SLSI standards, which mentioned as 0.05% per 1 kg of meat. Two experiments were conducted to determine the suitable and acceptable form of garlic for sausages recipe as fresh garlic or garlic powder. Each experiment consisted of 2 sub experiments and 3 replicates were prepared for each experiment. For determination of fresh garlic level (experiment 1) 10 g, 20 g, 30 g and 40 g was allocated for each 1 kg of chicken meat sausage. For the determination of garlic powder form (experiment 2) 3 g, 6 g, 9 g, 12 g was used for 1 kg of chicken meat. With several sensory evaluations contained optimal level of garlic powder and fresh garlic was determined from 5 g, 6 g, 7 g, 8 g and 9 g with powder and 10 g, 20 g, 30 g and 40 g with fresh form using 32 untrained panelists.

Changes in chemical, physical, sensory and microbiological parameters of prepared sausages with fresh garlic and powder garlic which stored immediately in refrigerator were analyzed over a period of 40 days. Proximate composition, pH, water holding capacity (WHC), and total plate count were determined in 3 days interval over the storage period for both treatments according to standard procedures (AOAC, 1995). Furthermore, total plate count (TPC) as in AOAC (1995) and Thio barbituric acid (TBA) value as described by Buege and Aust (1977) were analyzed in weekly intervals. As sensory characteristics of sausages, appearance, odor, color, taste and overall acceptability were evaluated by 32 untrained panelists. For each analysis 3 replicates were prepared and used. Statistical analysis for chemical and physical properties were analyzed though one way ANOVA using statistical software system and sensory data by Friedman test using MINITAB 15 statistical software package at the 95% confident interval.

Results and Discussion

Proximate analysis

The results of proximate analysis showed a significant difference in moisture content, ash content, crude protein content and crude fat content for each sample. Among three samples fiber content has not shown a significant difference ($p>0.05$). Among the samples the highest protein was recorded in fresh garlic incorporated sausages.

Sensory evaluation

From sensory evaluation of two fresh garlic levels as 30 g and 20 g/1 kg of chicken meat (experiment 1) in the preliminary trials, showed significant difference in sensory characteristics. Fresh garlic with 30 g/1 kg of chicken meat level was selected as the best recipe. Similarly, 7 g of garlic powder/1 kg of chicken meat has shown higher ($p>0.05$) sensory scores and it was determined as best garlic powder level out of 6 g, 7 g, 8 g and 9 g /1 kg of chicken meat (experiment 2).

Chemical analysis

TBA values have increased ($p<0.05$) lower than that of the acceptable range during refrigerated storage time in all three samples. However, changes were significantly different between control and two garlic incorporated samples ($p<0.05$). TBA values of the fresh garlic incorporated samples are slighter lower than ($p<0.05$) control sample (figure 1). Therefore, garlic in chicken sausages showed a better antioxidant effect than BHT. High fat containing products have the tendency to increase the TBA value with the time at the range from 0.1 to 1.2 malonildihyde mg/kg. Due to the lipid oxidation, TBA value may increase during the initial storage and start to slow down after a few days and this is because of the malonaldehyde decomposition and polymerization (Mulla, 2002).

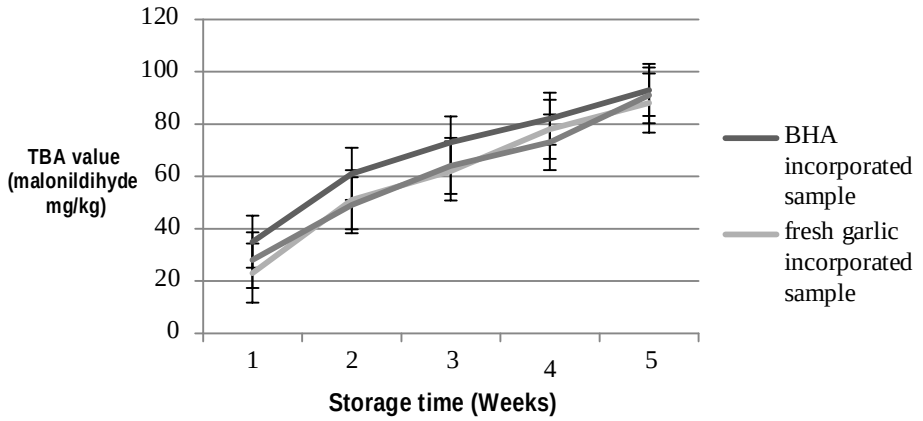

Figure 1. Changes of TBA values of garlic incorporated chicken sausages during storage at 4 ℃

There was no significant difference between the pH in the control and the garlic treated samples ($p>0.05$). pH values have significantly decreased throughout the study period under refrigerated storage (4 ℃) in all the samples . The maximum pH was recorded in day 01 in the garlic powder incorporated sample as 6.60±0.06. After 40 days, the pH was recorded as 5.00±0.01 in all the samples.

Furthermore, WHC has decreased ($p<0.05$) in both control and treatments throughout the storage period. However, in garlic incorporated sausage slightly lower values were observed in WHC compared to BHA incorporated sausages.

The TPC values also showed significant difference between the three samples over the refrigerated storage where as fresh garlic incorporated sausages showed significantly lower log CFU values at the first three weeks over storage. This may be due to the bioactive constituents founds in crushed garlic called "Allyl sulfur compounds" (Ankri and Mirelman, 1999). Further, they reported that allicin is a sulphur containing compound and oxygenated sulphur compound formed when garlic cloves are crushed. Furthermore, it showed that allicin exhibits its antimicrobial activity mainly by immediate and total inhibition of RNA synthesis, although DNA and protein syntheses are also partially inhibited. Hughes and Lawson (1991) also reported that the antimicrobial activity of garlic was completely abolished when allicin were removed from the extract.

Conclusions

This study showed that addition of fresh and powder form of garlic significantly decreased TBA value and microbial count of the chicken sausages. Furthermore, samples with addition of garlic had significant higher overall acceptance with 30 g fresh garlic/kg of chicken meat or 7 g of garlic powder/kg of chicken meat. In conclusion, fresh garlic has been demonstrated to improve chicken sausage quality and function such as antioxidant and antimicrobial effects as a promising natural ingredient applied as well as extended the shelf-life of chicken sausages by 4 weeks.

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