A COMPARATIVE STUDY ON THE EFFECTIVENESS OF ADDING ROSEMARY AND GINGER EXTRACTS ON MEAT QUALITY DURING FREEZING STORAGE*

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ABSTRACT
The aim of this experiment was to determine the effect of adding rosemary (0.05%) and ginger extracts (0.5%) on microbial and oxidative stability in meat lamb stored at -18º c for 150 days. Results revealed that there is steady rise (p<0.01) in microbial count and oxidative rancidity in untreated and treated samples with increasing storage period up to 150 days. Also, a significant (P≤0.01) reduction in all bacteria count (P≤0.01), TBA was observed in samples treated with ginger or rosemary extracts as compared with untreated samples. It was noticed that addition of ginger extract is more effective against formation of TBA than rosemary extract, however no difference exist between them on antimicrobial agent.

Keywords: Lamb patties, Natural Antimicrobial , Antioxidant, Rosemary Extracts , Ginger Extracts.

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INTRODUCTION
Meat is the muscle tissue of an animal which is rich in high quality protein, minerals, lipids with a small amount of carbohydrates. Due to its highly perishable nature, they are often very much susceptible to oxidation and microbial attack at any stages of processing, handling and storage (26). It is known that the most common form of chemical deterioration is the oxidation of meat lipids, it is a complex process which depends on chemical composition of meat, light, oxygen access, storage temperatures and may also affected by some technical procedures followed during meat processing (17). Lipid oxidation and microbial growth can be reduced by applying either synthetic or natural antioxidant and antimicrobial agents to the meat products processing to improve its quality, shelf-life and safety (18). Synthetic food additives i.e (butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), tert-butylhydroquinone (TBHQ) and propyl gallate (PG)) have been widely used for inhibiting lipid oxidation and microbial growth in meat products due to their strong antioxidant and antimicrobial activities, and their low production cost and easy accessibility (10), however due to the fact that synthetic antioxidant may constitute a potential health hazard for consumers (7), therefore natural antioxidants are used which are obtained mainly from various parts of the plant material like herbs and spices. Among these, the rhizome of the ginger species, (Zinger officinale) is widely used as a spice and food seasoning due to its sweet aroma and pungent taste. It has also been known to have antioxidant activity (20, 33) and is effective as antimicrobial (16, 30) due to the presence of gingerol and shogaol (15). Also rosemary have been used as successful antioxidants in vacuum packaged raw ground beef and pork (27), cooked ground beef (2), and more effective than a combination of BHA/BHT in raw frozen sausage (29), due to its content certain compound rosmanol, rosmariquinone, rosmaridiphenol, carnosol (11, 13). Therefore, the objective of the this study was to compare the potential role of adding ginger and rosemary extracts on inhibition the microbes and oxidation of meat lamb patties during freezing storage.

MATERIALS AND METHODS
Ginger rhizomes(Zingiber officinal) and rosemary (R. officinalis) were obtained from local market in Duhok. Full details of the extraction methodology and determinations of active compounds was carried out according to Baker et al (5).

Preparations of lamb patties
The patties was obtained from Karadi lambs carcasses( longissimus dorsi muscle). A combination of salt (70% NaCl and 30% KCl) based on our previous work (6) was added at a rate of 1.5% to the minced meat. Then the minced meat was subdivided into three equal parts. Control (C) was formulated without adding plant extracts. The other treatments were prepared by adding the optimum concentrations determined by the tested extracts from our previous study (6). Treatment 2 was blended with 0.05% rosemary extract (RE), treatment 3 was blended with 0.50% of ginger extract (GE) and formed into patties (50 g) using a meat former (10-cm wide and 1-cm thick each). Patties were placed on plastic foam meat trays, wrapped with polyethylene film and kept in a refrigerator at -18 °C for 150 days, and evaluated for chemical and microbial count at 1, 60, 90, 120 and 150 days of storage.

Microbial count
Microbial count(Total plate count, coliform, Psychrophilic bacteria, CFU/g) was determined as recommended by the American Public Health Association for food stuff examination (APHA) (3),. Proteolytic and lipolytic bacterial counts were determined as recommended by Harrigan and MacCance (14). Analytical methods
Lipid oxidation as thiobarbituric acid (TBA) was determined according to the method described by Witte et al ,(32). The results were expressed as mg malonaldehyde (MDA)/kg meat sample. Measurement of myoglobin (Mb)
The concentration of myoglobin in the minced meat was determined as described by krzywicki (19).
Statistical analysis

General Linear Model was used to estimate Best Linear unbiased effects (28) of treatment, storage period and their interaction, on all studied traits. Duncan multiple range tests (9) was used to detect significant differences among means of treatment combination (treatments X period).

RESULTS AND DISCUSSION

Microbial change

In the present study, results revealed that there is a significant(p<0.01) steady rise in all bacterial count with increasing storage period up to 150 days from their initial values in control of TPC (39 vs 78X10^5, GE 10.33 X10^5 vs 20.40 X10^5, RE 11.5 X10^5 vs 20.3 X10^5), coliform ( Control 88 vs 141.66X10^2,GE 16.66 X10^2 vs 30.13 X10^2, RE 16 X10^2 vs 30.5 X10^2), PSY ( control 14.76 vs 70.00X10^2,GE 6.1 X10^2 vs 13.4 X10^2,RE 6.2 X10^2 VS 14.1 X10^2), proteolytic ( control 29.00 vs 62.00X10^5,GE 8.2 X10^5 vs 17.6 X10^5,RE 9.2 X10^5 vs 16.3 X10^5) and lipolytic ( control 27.70 vs 52.00X10^2,GE 9.2 X10^2 vs 13.4 X10^2,RE 9.2 X10^2 VS 20.3 X10^2), Proteolytic, lipolytic count of lamb patties stored at -18°C for 150 days (mean ±s.e).

| Parameter                          | Storage days at -18C |
|-----------------------------------|----------------------|
|                                   | 1                    | 60                   | 90                   | 120                  | 150                  |
| TPC                               |                      |                      |                      |                      |                      |
| C                                 | 39.00±0.57 e         | 45.00±0.57 d         | 55.00±0.57 c         | 67.00±2.3 b          | 78.00±1.732 a        |
| RE                                | 11.50±0.288 i        | 12.80±0.115bh        | 14.20±0.208 h        | 17.6±0.173 g         | 20.3±0.173 f         |
| GE                                | 10.33±0.444 i        | 14.0±0.288h          | 15.3±0.152 hg        | 17.6±0.264 g         | 20.4±0.173 f         |
| Coliform                          |                      |                      |                      |                      |                      |
| C                                 | 88.00±1.154 e        | 96.66±0.881 d        | 115.33±1.763 c       | 125.0±0.577 b        | 141.66±1.452 a       |
| RE                                | 16.56±0.233 j        | 19.5±0.251 i         | 26.53±0.145 h        | 28.73±0.405 gfh      | 30.5±0.288 f         |
| GE                                | 16.66±0.202 j        | 19.5±0.321 i         | 26.86±0.145 h        | 28.03±0.433 gh       | 30.13±0.357 gf       |
| PSY                               |                      |                      |                      |                      |                      |
| C                                 | 14.76±0.145 e        | 25.0±1.732 d         | 44.0±2.309 c         | 62.0±0.577 b         | 70.0±0.577 a         |
| RE                                | 6.20±0.115 h         | 7.2±0.00 h           | 8.6±0.115 gh         | 11.0±0.200 f         | 14.10±0.200 e        |
| GE                                | 6.7±0.187 h          | 7.8±0.461 h          | 10.4±0.230 gfh       | 13.4±0.230 e         |                      |
| Protolytic                        |                      |                      |                      |                      |                      |
| C                                 | 29.00±0.57 e         | 32.0±0.57d           | 41.0±0.57c           | 44.3±0.88h           | 62.0±1.154 a         |
| RE                                | 9.20±0.115 k         | 11.10±0.115 j        | 12.7±0.057 i         | 14.2±0.152 hg        | 16.3±0.152 f         |
| GE                                | 8.2±0.115 k          | 11.10±0.404 j        | 12.8±0.115 hi        | 14.4±0.230 g         | 17.6±0.346 f         |
| Lipolytic                         |                      |                      |                      |                      |                      |
| C                                 | 27.90±0.17 e         | 34.0±1.15 d          | 38.0±1.15 e          | 41.0±1.15 b          | 52.0±1.154 a         |
| RE                                | 10.33±0.333h         | 11.80±0.115gh        | 12.20±0.100gfh       | 12.8±0.200 f         | 14.3±0.057 f         |
| GE                                | 9.2±0.986 i          | 9.2±0.230 i          | 11.0±0.500 gh        | 12.10±0.115 gh       | 12.8±0.152 gf        |

For each trait, means with different letters within each column and each row differed significantly (p<0.01).

C=control, RE=rosemary extract, GE=ginger extract

TBA: The effect of addition rosemary or ginger extracts and storage time on TBA are demonstrated in Table(2). TBA of patties in the control ,GE ,RE started to increase significantly (p<0.01) from 1.75, 0.53, 0.64 at day one to 3.84, 1.32, 1.58 mg MDA/kg meat.
at 150 days, respectively. It seems from Table (2) that TBA values of the patties with the added either rosemary or ginger extracts were significantly (p<0.01) lower than control during the entire period of the experiment. Moreover, it was also noticed that the addition of ginger extract is more effective as an antioxidant as compared with the addition of rosemary. Similarly, Formanek et al., (12), Ibrahim et al., (16), and Abu-almaaly (1) reported that ginger extract as antioxidant was effective against TBA formation when incorporated into meat during frozen storage. This result was consistent with studies in hog sausage (25), and precooked roast beef (22). The antioxidant activity of rosemary extracts was also confirmed by Mathenjwa et al. (21) on pork and beef sausage, which were stored in a frozen state for 180 and 100 days, respectively. Such activity of rosemary is due to its content of phenolic primary antioxidants which react with lipid or hydroxyl radicals and convert them into stable products (23, 31).

**Table 2. Effect of adding rosemary or ginger extracts to lamb patties on TBA (mg(MDA)/kg meat) and Myoglobin (Mb) (mg/gm meats) values stored at -18°C for 150 days (means±s.e.).**

| Parameter | 1 | 60 | 90 | 120 | 150 |
|-----------|---|----|----|-----|-----|
| C         | 1.75±0.00 d | 2.33±0.004 e | 3.00±0.03 b | 3.101±0.02b | 3.84±0.004 a |
| RE        | 0.641±0.00 i | 0.868±0.03h | 1.065±0.012g | 1.372±0.051 f | 1.588±0.013 e |
| GE        | 0.533±0.0138 j | 0.605±0.010 ji | 0.652±0.019 i | 1.013±0.000 g | 1.328±0.0135 f |
| Myoglobin Mb | 1.257±0.00 e | 2.30±0.11 f | 1.257±0.000 h | 1.031±0.0129 i | 1.05±0.029 i |
| RE        | 4.527±0.0 a | 3.191±0.015 d | 2.560±0.066 e | 1.378±0.027 h | 1.05±0.029 i |
| GE        | 4.243±0.073b | 2.297±0.020 f | 1.792±0.068 g | 1.065±0.026 i | 1.048±0.000 i |

For each trait, means with different letters within each column and each row differed significantly (p<0.01). C=control, RE=rosemary extract, GE= ginger extract

It can be concluded from the results obtained from the current work that adding ginger and rosemary extracts are an effective antioxidant and antimicrobial agents for the control spoilage and extend the shelf life of lamb meat. This study show that ginger was highly effective in reducing lipid oxidation than rosemary but no difference exist between them on their effect as antimicrobial agents. Further studies on the effect of adding together ginger and rosemary on lipid oxidation and microbial count in meat is recommended.

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