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 the 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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مجلة العلوم الزراعية العراقية -2020 :51(1):333-338 بكر والقس

دراسة مقارنة لفعالية المستخلصات المضافة لاكليل الجبل والزنجبيل في نوعية اللحوم خلال الخزن بالتجميد

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المستخلص

تهدف الدراسة الحالية متابعة تأثير مستخلص كل من اكليل الجبل (0.05%) والزنجبيل (0.05%) في منع الاكسدة وتقليل الحمل المايكروبي لاقراص لحم الحملان المخزونة بالتجميد (-18ºم) لمدة 150 يوما. اشارت النتائج وجود زيادة معنوية (أ<0.01) في العد البكتيري والتزنخ التاكسدي في النماذج المعاملة وغيرالمعاملة بتقدم الخزن لمدة 150 يوم. كما وجد انخفاض معنوي (أ<0.01) في العد البكتيري وقيم TBA في النماذج المعاملة باكليل الجبل والزنجبيل مقارنة بمعاملة السيطرة. كما تبين بان مستخلص الزنجبيل كان اكثر فعالية من مستخلص اكليل الجبل في خفض قيم TBA في حين كانت فعاليتها متماثلة في التأثير على العد البكتيري.

الكلمات المفتاحية: اقراص لحم الحملان, مضادات الاكسدة والبكتريا الطبيعية, مستخلصات اكليل الجبل والزنجبيل.

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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 $X10^5$ vs20.40 $X10^5$, 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 $70.00X10^5$,GE 6.1 $X10^5$ vs 13.4 $X10^5$,RE 6.2 $X10^5$ VS 14.1 $X10^5$,), 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 $52.00X10^5$, GE 9.2 $X10^5$ vs 12.8 $X10^5$, RE 10.33 $X10^5$ vs 14.3 $X10^5$) , respectively (Table 1). Also, the results indicate that addition of rosemary and ginger extracts resulted in significantly ($p<0.01$) reduction on all counts of studied bacteria . However, it was noticed that there is no significant difference in adding either ginger or rosemary extracts in all studied traits (Table1). The use of natural antimicrobials such as organic acids, essential oils, plant extracts could be considered as a good strategy to inhibit microbial spoilage of meat products (24). The plant extracts and essential oils demonstrated potential antimicrobial effects according to the following mechanisms: (a) The phenolic compounds in these extracts and essential oils affect either enzyme activity or cause protein denaturation . (b) It causes changes in the permeability of microbial cells.(c) It causes changes in the functions of the normal activity of cell membranes such as electron transfer, nutrient exchange, protein synthesis, nucleic acids and enzymatic activity (4). Similarly, it has been shown that added rosemary and ginger have an inhibitions effect on bacteria (6, 30) Table (1) Effect of rosemary and ginger extracts on changes in total plate count (TPC), coliform, psychrophlic (PSY), proteolytic, lipolytic count of lamb patties stored at -18°C for 150 days (mean ±s.e.).

Table 1. Effect of adding rosemary or ginger extracts on changes in total plate count (TPC), coliform, psychrophlic (PSY), proteolytic, lipolytic count of lamb patties stored at -18°C for 150 days (mean ±s.e)

Parameter	Storage days at -18c				
TPC	**1**	**60**	**90**	**120**	**150**
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**	**12.800±0.115hi**	**14.20±0.208 h**	**17.6±0.173 g**	**20.30±0.173 f**
GE	**10.333±0.44 i**	**14.0±0.288h**	**15.3±0.152 hg**	**17.60±0.264 g**	**20.4±0.173 f**
		Coliform			
C	**88.00±1.154 e**	**96.666±0.881 d**	**115.333±1.763 c**	**125.0±0.577 b**	**141.666±1.452 a**
RE	**16.566±0.233 j**	**19.5±0.251 i**	**26.533±0.145 h**	**28.733±0.405 gfh**	**30.50±0.288 f**
GE	**16.666±0.202 j**	**19.5±0.321 i**	**26.866±0.145 h**	**28.033±0.433gh**	**30.133±0.357 gf**
		PSY			
C	**14.766±0.145 e**	**25.00±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**	**8.60±0.115 gh**	**11.10±0.200 f**	**14.10±0.200 e**
GE	**6.1±0.057 h**	**6.7±0.173 h**	**7.8±0.461 h**	**10.40±0.230gf**	**13.40±0.230 e**
		Protolytic			
C	**29.00±0.57e**	**32.00±0.57d**	**41.00±0.57c**	**44.333±0.88b**	**62.00±1.154a**
RE	**9.200±0.115k**	**11.100±0.115j**	**12.70±0.057i**	**14.2±0.152hg**	**16.3±0.152f**
GE	**8.2±0.115k**	**11.100±0.404j**	**12.8±0.115hi**	**14.40±0.230g**	**17.6±0.346f**
		liypolytic			
C	**27.90±0.17 e**	**34.00±1.15 d**	**38.00±1.15 c**	**41.00±1.15 b**	**52.00±1.154 a**
RE	**10.333±0.333ih**	**11.800±0.115gh**	**12.200±0.100gfh**	**12.8±0.200 gf**	**14.3±0.057 f**
GE	**9.2±0.986 i**	**9.20±0.230 i**	**11.00±0.500 gih**	**12.10±0.115gh**	**12.80±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)

Myoglobin (Mb)

As it is evident from Table (2) that color values in term of myoglobin are decreased significantly ($p<0.01$) in all treatments with increasing storage period . Also, it appears from Table (2) that addition of rosemary and ginger extracts resulted in a significantly ($p<0.01$) higher values of myoglobin as compared with the control . Additionally it was show that rosemary is more effective than ginger in stabilizing color up to 120 days of storage. Similarly, Rojas and Brewer (27) noticed a reduction in color throughout the frozen storage time, regardless of the treatment used. It is known that Mb loss was due to the oxidation of myoglobin to metamyoglobin, and rosemary retard this process to maintain meat redness longer. Also, a reduction in metamyoglobin formation was noticed and intense red color obtained in fresh beef steaks whose surface was sprayed with rosemary during refrigeration (8).

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	Storage days at -18c				
TBA	**1**	**60**	**90**	**120**	**150**
C	**1.75±0.0d**	**2.33±0.004 c**	**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**
		Mb			
C	**3.93±0.01 c**	**2.54±0.02 e**	**2.30±0.11 f**	**1.257±0.000 h**	**1.031±0.0129 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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