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جامعة عين شمس، كلية التربية النوعية، القاهرة، مصر

تحية طيبة وبعد،،،

يسر **معامل التأثير والاستشهادات المرجعية للمجلات العلمية العربية (ارسيف – ARCIF)**، أحد مبادرات قاعدة بيانات **"معرفة"** للإنتاج والمحتوى العلمي، إعلامكم بأنه قد **أطلق التقرير السنوي التاسع للمجلات للعام 2024**.

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ختاماً، نرجو في حال رغبتكم الحصول على شهادة رسمية إلكترونية خاصة بنجاحكم في معامل " **ارسيف** "، التواصل معنا مشكورين.

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محتويات العدد

أولاً : بحوث علمية محكمة باللغة العربية :

- الكتابات القبطية القديمة كمدخل لإثراء التصميم الزخرفي من خلال الكمبيوتر

ا.د/ وائل حمدي عبد الله القاضي ٩٨٧
ا.د/ أسماء عاطف محمد موسي
د/ نجلاء محمد عبد الحميد الخولي
ا/ مونيكا صفوت اسحق دوس

- مستوى تقديم التغذية الراجعة (تصحيحية / تفسيرية) بروبوتات الدردشة وأثرها في تنمية مفاهيم مستحدثات تكنولوجيا التعليم لدى طلاب تكنولوجيا التعليم

ا.د/ هويدا سعيد عبد الحميد السيد ١٠١١
ا.م.د/ زينب محمد العربي إسماعيل
د/ نرمين محمد إبراهيم نصر
ا/ سميه سلامه فراج السيد

- التفاعل بين نمط الدعم (موجز- تفصيلي) ببيئة تعلم إلكترونية ذكية قائم على الشات بوت ومستويات تجهيز المعلومات (سطحي-عميق) وأثره في تنمية مهارات البرمجة والانخراط في التعلم لدي طلاب المرحلة الثانوية ١١٠٣

ا.د/ محمد أحمد فرج موسى
د/ محمد عنتر محمد
ا/ محمود رجب أحمد محمد

- أثر برنامج تدريبي فى تصميم بعض الملابس الخارجية للسيدات بإستخدام أدوب إليستيراتورAdobe Illustrator

ا.د/ غادة رفعت أحمد ١١٩٧
ا.د/ منصورة سليمان سيد
ا/ حنان سيد مراد

- دراسة مقارنة لجودة الرعاية الغذائية بين مستشفى كفرالشيخ العام ومستشفيات بيلا المركزي وسيدي غازي المركزي وعلاقتها برضا المرضى

ا.د/ لمياء محمود لطفي الصادق ١٢٥١
ا.د/ مرفت إبراهيم متولي الدميري
ا.م.د/ نيبال فيصل عبد الحميد محمد
ا/ ريحاب دسوقي أحمد أبوسكين

ثانياً : بحوث علمية محكمة باللغة الإنجليزية :

- Antimicrobial and antioxidant activity effect of ginger and marjoram on chicken burger

Prof. Mona Samy Halaby
Prof. Abd El-Aziz Nadir Shehata
Dr. Fatma Mohamed Abd Allah
Eman Ramadan Mostafa 127

- Evaluation of the antimicrobial and antioxidant activity effect of sumac and thyme on beef burger

Prof. Mona Samy Halaby
Prof. Abd El-Aziz Nadir Shehata
Dr. Fatma Mohamed Abd Allah
Eman Ramadan Mostafa 153

- The Effect of Nutrition Education Program on the Nutrition Status of Bariatric Surgery Patients

Prof. Mona Samy Halaby
Prof. Eman Mokbl Ghalab
Prof. Doaa Zakaria Zaky
Sara Salah Youssef Mohamed 177

- The Effect of Fish Oil Enriched with Omegas on Cardiovascular Diseases in Experimental Rats

Prof. Usama El-Saied Mostafa
Prof. Walaa Ibrahim Mohamed
Dr. Hala Rashed Ataya
Maha Ashraf El-Sayed Abdullatif 193

- Using of Ajwain (Tracyspermum ammi L.) and Its Extracts in Prevention of Hepato-Renal Toxicity in Experimental Rats

Prof. Eveleen Said Abdalla
Prof. Aymen Fathy Khalil
Prof. Eshak Mourad El-Hadidy
Manal Milad Abd El Shaheed 217

Antimicrobial and antioxidant activity effect of ginger and marjoram on chicken burger

Prof. Mona Samy Halaby (1)

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Antimicrobial and antioxidant activity effect of ginger and marjoram on chicken burger

Prof. Mona Samy Halaby
Prof. Abd El-Aziz Nadir Shehata
Dr. Fatma Mohamed Abd Allah
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Abstract

This study was conducted to evaluate the effect of different natural herbs (Ginger and Marjoram) as antimicrobial and antioxidant activity on chicken Burger. In this study, three levels of ginger (1%, 2 % and 3%) and Marjoram (1.5%, 2.5% and 3.5%) were used in chicken preparation as compared to control sample. Results of chemical composition for herbs showed Ginger were higher in (fats and carbohydrates) content, while Marjoram was higher in (protein, moisture, ash and fibre) content. As results for Total phenolic content and antioxidant activity of herbs it was found that marjoram was higher and stronger than ginger. During storage period at (4 ±1oC) for 14 days Data obtained cleared that highest inhibition ratio of pH value and (Mold and yeast count) found in samples with ginger compared to other samples.

Keywords: Ginger, Marjoram, chicken Burger, Antimicrobial, Antioxidant, Total phenolic.

ملخص:

العنوان : التأثير المضاد للميكروبات ومضادات للأكسدة للزنجبيل والبردقوش على برجر الدجاج

المؤلفون : منى سامي حلبي، عبد العزيز ندير شحاته، فاطمة محمد عبدالله، إيمان رمضان مصطفى

أجريت هذه الدراسة لتقييم تأثير الأعشاب الطبيعية المختلفة (مسحوق الزنجبيل والبردقوش) كمضادات للميكروبات ومضادات الأكسدة على برجر الدجاج. في هذه الدراسة تم استخدام ثلاثة مستويات من الزنجبيل (1%، 2%، 3%) والبردقوش (1.5%، 2.5%، 3.5%) في تحضير الدجاج مقارنة بالعينة الضابطة. أظهرت نتائج التركيب الكيميائي للأعشاب أن الزنجبيل كان أعلى في محتوى العناصر الاتيه (الدهون والكربوهيدرات) بينما كان البردقوش أعلى في محتوى في (البروتين والرطوبة والرماد والألياف). أما بالنسبة للمحتوى الفينولي الكلي والنشاط المضاد للأكسدة للأعشاب فقد وجد أن البردقوش أعلى في محتواه من المركبات الفنيولية وأقوى في النشاط المضاد للاكسدة مقارنة بالزنجبيل. كما أظهرت النتائج التي تم الحصول عليها اثناء فترة تخزين برجر الدجاج عند درجة حرارة (4±1oC) لمدة 14 يوما, أن أعلى نسبة تثبيط لقيمة الرقم الهيدروجيني و(عدد العفن والخميرة) وجدت في العينات المحتوية علي الزنجبيل مقارنة بالعينات الأخرى

الكلمات الدالة : الزنجبيل, البردقوش, برجر الدجاج , مضادات الميكروبات، مضادات الأكسدة، الفينول الكلي

Introduction

Poultry meat refers to the edible portion of any domesticated avian species, such as chicken, duck, turkey, geese, guinea fowl, and Japanese quail. Poultry, especially chicken, is one of the most widely consumed muscle foods in the world **(Fehri *et al.*, 2022).**

In Egypt, chicken occupy the major role in production and consumption among poultry. Chickens appear more frequently than any other food animals, so acts as a main source of protein in the diet of the people throughout the world. Chicken meat becomes the second most popular meat eaten after red meat. Chicken meat is characterized by ease during preparation, consistent quality and the availability of the wide range of pre-packed branded, raw and ready to eat and serve products. Meat from chicken is usually used because of the high chicken meat yield, low shrinkage during cooking, ease of cooking and serving and of low cost **(Hassanina *et al.*, 2021)**.

Nutritional Quality Chicken meat, like other animal protein, is considered a high-quality protein containing highly bioavailable amino acids; minerals such as phosphorus, iron, zinc, iodine; and vitamin B_{12}. However, poultry meat is low in saturated fats and has a higher protein to fat ratio. This may be especially prominent when consuming a skinless breast fillet for example **(Fehri *et al.*, 2022).** Poultry fat is composed primarily of monounsaturated fats, with less than 1/3 being the less desirable saturated fats. Compared to red meat, Chicken fat is considerably less saturated and contains almost no trans fats. Moreover, Chicken meat contains the essential polyunsaturated fatty acids (PUFAs), including Omega-3 fatty acids **(Garg *et al.*, 2017)**.

Today's consumers look for healthier and more practical meat products, preferably with no synthetic chemical additives but still with pleasant and attractive colour and taste and it rests to the food technologists the challenge to develop new products to

meet that demand **(Sales *et al.*, 2015).** Culinary spices and herbs have been used in food and beverages to enhance aroma, flavour, and colour. They are rich in phytochemicals that provide significant antioxidant and anti-inflammatory effects. There is growing interest in identifying compounds from spices and herbs responsible for modulating oxidative and inflammatory stress to prevent diet-related diseases **(Embuscado, 2019)**.

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 been known to have antioxidant activity and effective as antimicrobial. Ginger oil inhibits Aspergillus, a fungus known for production of aflatoxin, a carcinogen (**Indiarto** and **Rezaharsamto, 2020a).** Ginger is widely used in food processing, such as meat products, pickled ginger, biscuits, candy, gingerbread, beer (ginger ale), powder and syrup (**Indiarto** and **Rezaharsamto , 2020b)** . Processed ginger in form ginger candy was able to reduce the rate of vomiting in pregnant women in the first trimester **(Anita *et al.*, 2020).** Adding ginger extract to turmeric white drinks increases antioxidant activity. It is due to phenolic compounds in ginger, which play a role in eliminating free radicals and radicals **(Sueishi *et al.*, 2019).**

(Origanum *majorana L)* Marjoram, also called sweet marjoram, is a cold-sensitive perennial herb or under- shrub with a fine aroma. Marjoram was reported to contain high amounts of bioactive polyphenolic compounds that are very useful for health and have its therapeutic effects (**El-Wakf *et al.*, 2020).** Marjoram is a high antioxidant and high antimicrobial plant that was used in folk medicine for decades in many uses. Marjoram was added in two different forms; ethanolic extract at (0.1, 0.2 and 0.3 g/ 100g), and dried powder (0.2, 0.4 and 0.6 g/100g). More study suggests the application of marjoram in beef burger as ethanolic extract or dried powder because it improved its quality and sensory parameters **(Ragab *et al.*, 2020).**

Uses Marjoram oil can be used as a flavour in liquor, liqueurs, sauces, and condiments. Both the oil and oleoresin can

be used in various meat preparations such as sausages, chicken preparations, and special soups. The oil finds use as a fragrance in soaps and perfumes **(Badee *et al.*, 2013).**

Therefore, the present study aims to investigate the effect of different types of herbs (Ginger and Marjoram) as antimicrobial and antioxidant activity on quality of chicken products.

MATERIALS AND METHODS

A. MATERIALS:

Chicken breast meat and fat were purchased from the local butcher market in Giza, Egypt. Salt and starch were purchased from the local market in Cairo, Egypt. Herbs (Ginger and Marjoram) were purchased from the Food Technology Research Institute, Agricultural Research Centre, and Giza.

B. METHODS:

1. Herbs Preparation:

Dried herbs (Ginger and Marjoram) were ground in miller. The powder was passed through a 50-mesh sieve.

2. Chicken Burger Preparation:

Chicken Burger was prepared according to **(Wan Rosli *et al.*, 2006).** Herbs powder was added at three levels as following: Ginger (1%, 2% and 3 %), Marjoram (1.5%, 2.5% and 3.5%). The ingredients of the control and the tested formulas were shown in Table (1).

Table (1): Ingredients of the control and the tested formulas of Chicken Burger.

Ingredients	Control	Ginger			Marjoram		
		Formula 1	Formula 2	Formula 3	Formula 4	Formula 5	Formula 6
Chicken breast meat (g)	70	70	70	70	70	70	70
Salt (g)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Starch (g)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Fat (g)	15	15	15	15	15	15	15
Cold water (ml)	10	10	10	10	10	10	10

Ginger (g)	-	0.7	1.4	2.1	-	-	-
Marjoram (g)	-	-	-	-	1	1.5	2.5

Formula (1) = 1% Ginger Formula (2) = 2% Ginger Formula (3) = 3% Ginger
Formula (4) = 1.5% Marjoram Formula (5) = 2.5% Marjoram Formula (6) = 3.5% Marjoram

3. Chemical composition of herbs and Chicken Burger products:

Chemical analyses of herbs and the Chicken burger samples treated with best level of herbs powder after doing sensory evaluation were determined according to **AOAC (2016).** Total carbohydrates were calculated by the difference method.

4. Determination of Total phenolic content and antioxidant activity of herbs: Total phenolic content was determined in herds according to **(Beretta et al., 2005).** Antioxidant activity of herbs was determined by DPPH assay using a spectrophotometer at 517 nm according to **(Goze *et al.*, 2009).**

5. <u>Physicochemical Properties of Chicken Burger Products:</u>

a. Water holding capacity (WHC): Water holding capacity (WHC) was measured using the method of **El-Seesy (2000)** as percentage (%) using the following equation:

$$\mathbf{WHC} = \frac{\text{inner area } (mm^2)}{\text{outer area } (mm^2)} \times 100$$

6. <u>Evaluation of Cooking Properties:</u>

a) Cooking loss was calculated using the method reported by **Jama *et al.*, (2008)** according to the following equation:

$$\textbf{Cooking loss } (\%) = \frac{\text{wt. of raw sample} - \text{wt. of cooked sample}}{\text{wt. of raw sample}} \times 100$$

b) Cooking yield was determined according to **(El-Magoli *et al.*, 1996),** using the following equation:

$$\textbf{Cooking yield } (\%) = \frac{\text{Cooked weight}}{\text{raw weight}} \times 100$$

c) Shrinkage (%) of the tested samples was determined according to the following equation **(El-Magoli *et al.*, 1996):**

$$\text{Shrinkage}\ (\%) = \frac{\text{Fresh sample diameter} - \text{cooked sample diameter}}{\text{Fresh sample diameter}} \times 100$$

7. Effect of herbs on the storage stability of prepared Chicken Burger: Samples of Chicken Burger as well as the control (untreated) was stored at (**4 ±1ºC**) for 14 days and evaluated in (0, 4,8,14 days) by the following parameters.

a) The pH values were determined as described by **Hayes *et al.*, (2010).**

b) Thiobarbituric acid (TBA) of burger samples was determined using the method described by **(Pearson, 1991).**

c) Microbiological analysis: Total bacterial count (log cfu/g) of burger samples was determined as described by **(The American Public Health Association) APHA (2001).** For mold and yeast count: Yeast Extract Agar (Merck, Darmstadt, Germany) was incubated for 5 days at 25°C **(Petrou *et al.*, 2012).**

8. Sensory evaluation:

Sensory evaluation was carried out by (20) panelists from the National Research Center and the Technical Research, Quality Control and Assurance Department of the National Service Projects Agency, in Egypt, using a numbered scorecard form of 5-points (1=lowest quality to 5= highest quality) according to **Klein, (1984)** and **(Penfield** and **Campbell, 1990).** Chicken Burgers were evaluated after cooking for: appearance, color, texture, juiciness, taste, odor and overall acceptability properties.

9. Statistical analysis:

Statistical analysis was performed triplicates except sensory evaluation performed between ten replicates using SPSS V.15.0 for Windows. ANOVA was carried out on data of the chemical,

oxidation and microbiological evaluations **(Benjakul *et al.*, 2003).**

RESULTS AND DISCUSSION

1. Chemical composition of the herbs:

Chemical compositions (protein, fat, carbohydrate, moisture, ash and fibre) of two different types of herbs (Ginger and Marjoram) are presented in Table (2).

Table 2: Chemical composition (%) of herbs powder.

Chemical Composition (%)	Ginger	Marjoram
Protein	8.23	12.92
Fat	0.73	0.34
Carbohydrate	76.63	61.29
Moisture	7.86	12.94
Ash	6.55	12.51
Fibre	5.88	11.50

Protein content was higher in marjoram (12.92%). This value was higher than that reported by **Ragab *et al.*, (2020),** where protein value reached (12.66%) in marjoram. This may be due to the difference in soil or type of plant used. However, protein content of Ginger was lower (8.23%) and this value was higher in agreement with **Abdel-Naeem** and **Mohamed (2016)**, where it reached **(**7. 6 %) in Ginger.

Fat content was higher in Ginger (0.73 %) than that found in Marjoram (0.34 %). However, these values were contrary to what others found. Since, a higher fat percentage was found in Ginger (11.1%) in **Abdel-Naeem** and **Mohamed (2016)** and in Marjoram (7.1%). **(Ragab *et al.*, 2020).**

Moisture content was high in Marjoram (12.94%) and ginger (7.86%). This differs from what was reported by others. Since, moisture was lower (9.1%) in Marjoram **Ragab *et al.*, (2020)** and (10.1%) in ginger **Abdel-Naeem** and **Mohamed (2016)**. This difference may be due to the difference in soil or the types of plant used.

Marjoram had a higher ash value (12.51 %) compared to ginger (6.55 %). These obtained results disagreed with those reported by **Ragab *et al.*, (2020)** who reported that ash was **(**18.7%) in Marjoram and **Abdel-Naeem** and **Mohamed (2016)** who reported that ash was (5.18%) % in ginger.

Concerning fiber content, it was higher in marjoram (11.50%) than ginger (5.88%). These obtained results agreed with reported by **Ragab *et al.*, (2020)** who reported that fiber was (11.4%) in marjoram and disagreed with reported by **Abdel-Naeem** and **Mohamed (2016)** who reported that fiber was (7, 5%) in ginger.

2. Total phenolic content and antioxidant activity of herbs (inhibition %):

Data in Table (3) exhibited Total phenolic content of herbs powder (mg GAE/g) and revealed that Marjoram gave the highest amount of phenolic content (5.40 ± 0.14 mg GAE/g) this disagreement with **Dorman *et al.*, (2003)** was reported that phenolic content in marjoram by (97.9 mg GAE /g) also less than that reported by **kim *et al.*, (2011)** (20.44 ± 0.62). Than ginger gave (4.33 ± 0.12 mg GAE/g), While TPC of ginger was (67±2.86) higher than the values described by **Satter *et al.*, (2013)** which was (10±0.12 - 14±0.03 mg GAE /g) and **Kejing *et al.*, (2016)** was (11.97 ± 0.33 mg GAE /g).

Table (3): Total phenolic content (mg GAE /g) of herbs (inhibition %).

Herbs	Ginger	Marjoram
Total phenolic	4.33 ± 0.12	5.40 ± 0.14

Table (4): Antioxidant activity of herbs levels using DPPH method (inhibition %).

Herbs types	Herbs' Levels			
	Level (1)	Level (2)	Level (3)	IC50*
Ginger	24.35	32.56	44.25	238.42
Marjoram	25.55	34.32	45.15	181.44

*IC50 = Half-maximal inhibitory concentration

Formula (1) = 1% ginger Formula (2) = 2% ginger Formula (3) = 3% ginger
Formula (4) = 1.5% marjoram Formula (5) = 2.5% marjoram Formula (6) = 3.5% marjoram

Results in the Table (4), the IC_{50} values of the extracts hence it represents the lower concentration of herbs extract required to scavenge DPPH radical to 50%. The lower the IC_{50} value, the higher the antioxidant activity. Marjoram showed high antioxidant activity with IC_{50} values 181.44. (**Dauqan** and **Abdullah, 2017)** and **(Nieto, 2020)** those reported marjoram (IC_{50} values 181.44) because of had high total phenolics content was obtained at addition of dried marjoram leaves**.** Than ginger herb had (IC_{50} values 238.42) **(Mahmoud *et al.*, 2017)** and **(Mustafa** and **Chin, 2023).**

3. Physicochemical properties of treated formulated chicken burger:

a) Water holding capacity (WHC) of Chicken burger:

Data from Table (5) showed that the addition of Ginger and Marjoram at level (1.5%) increased the water holding capacity (WHC) of Chicken burger as compared to the control sample. The high values of WHC might be due to the ability of the extracts to retain water.

Table (5): Physical properties of Chicken Burger samples treated with different levels of herbs powder.

Physical Properties	Chicken Burger samples						
	Control	Ginger			Marjoram		
		Formula 1	Formula 2	Formula 3	Formula 4	Formula 5	Formula 6
WHC (%)	52.5	75.1	65.8	65.9	75.4	47.9	46.3
Cooking properties							

Cooking loss (%)	19	11	8	8	14	13	11
Cooking yield (%)	81	89	92	92	86	87	89
Shrinkage (%)	13.6	13.6	9	9	13.6	13.6	13.6

Formula (1) = 1% Ginger Formula (2) = 2% Ginger Formula (3) = 3% Ginger
Formula (4) = 1.5% Marjoram Formula (5) = 2.5% Marjoram Formula (6) = 3.5% Marjoram

It could be observed, samples with ginger levels of (1%, 2 % and 3%) had a higher WHC value (75.1%, 65.8%, and 65.9% respectively) than the control (52.5 %) due to the synergistic effects of the high protein content and the high fibre contents in the added dried powder of ginger .but the samples with Marjoram levels of (2.5 % and 3.5%) had a least WHC value (47.9%, and 46.3% respectively).

4. Evaluation of Cooking Properties:

a) Cooking loss:

From the data in table (5), it could be observed that, there was difference in cooking loss values between chicken burger treatments with types of herbs and control samples after processing at zero time.

It was noticeable that the samples treated with ginger at levels (1%, 2% and 3%) had a lower cooking loss value compared to the control and other treatments, which the values were (11%, 8%and8% respectively) and control sample was (19%). also found that samples treated with marjoram at levels (1.5%, 2.5% and3.5%) had a lower cooking loss value(14%,13% and 11%) compared to the control (19%) only but higher than cooking loss values for the samples treated with ginger. This improvement in cooking loss (lower cooking loss) was by the addition of herbs powder which is able to bind water and fat, consequently (**Rinaudo, 2006; El-demery, 2010** and **Mahmoud *et al.*, 2017).**Dietary fibres decreased cooking loss because of their high ability to keep moisture and fat in the matrix **(Besbes *et al.*, 2008).**

b)Cooking yield:

Data in Table (5), showed the Chicken Burger samples contain ginger at levels (1%,2%and3%) had higher cooking yield (89%,92% and 92%) respectively compared to the control (81%) and other treatments, followed by the samples contain marjoram at levels (1.5%,2.5%and 3.5%) which cooking yield values for marjoram (86%,87% and 89 %) respectively. These results were on line with **Darwish *et al.*, (2012)** and **Minin, (2013).**

c) Shrinkage:

The results in table (5), it was observed that the samples contain ginger at levels (2%, 3%) had the lowest shrinkage value (9%) compared to other samples, While, treatments which had herbs at levels (1%) ginger, (1.5%, 2.5%, 3.5%) marjoram and control sample had the same shrinkage rate (13.6%) and showed higher in shrinkage similar results were obtained with **(Abu-almaaly, 2011).** this might be attributed to excessive fat separation and water released which occurred during cooking and decreasing in water holding capacity (W.H.C)Similar results were obtained with **Woelfel *et al.*, (2012)**.

5. Effect of herbs on the storage stability of prepared burgers:

a)PH value

Measuring of pH value is important due to its influence on many characteristics, including shelf-life, colour, water holding capacity and texture of meat and meat products(**Mahmoud *et al* ., 2017)**.

Results in table (6), showed that PH of chicken burger treated with different levels of herbs powder ginger and marjoram during storage period at 4 $\pm 1^0$C for 14 days were. Results was noticed that chicken burger contain ginger at levels (1%, 2%, 3%) had less pH value during 4^{th} , 8^{th} and 14^{th} days compared with control sample and other treatments. These results were in agreement with **Darwish *et al.*, (2012)** and **(Mir *et al.*, (2017)**.

Followed by the samples contain with marjoram at levels (1.5%, 2.5%, 3.5%) which had less pH value compared with control sample. The decreasing in pH might be attributed to used ginger in the burger formulas which has been known to have effective as antimicrobial due to phenolic compounds in ginger (**Indiarto** and **Rezaharsamto, 2020a).** In addition to Marjoram was reported to contain high amounts of bioactive polyphenolic compounds that are very useful for health and have its therapeutic effects **(El-Wakf *et al.*, 2020).**

Table (6): Mean value PH of chicken burgers treated with different levels of herbs powder during storage at period 4 ±1ºC for 14 days:-

Days	Control	Chicken Burger samples					
		Ginger			Marjoram		
		Formula 1	Formula 2	Formula 3	Formula 4	Formula 5	Formula 6
1st day	5.41ac	5.44ab	5.43ab	5.43ab	5.42ab	5.43ab	5.42ab
4th day	6.10ab	5.71bb	5.70bb	5.69bb	5.81aa	5.80aa	5.78ab
8th day	6.48ab	6.15aa	6.14aa	6.14aa	6.17ab	6.16aa	6.15ab
14th day	7.64aa	6.36aa	6.35ba	6.35ba	6.61ba	6.60ba	6.59ba

Means in the same column followed by different letters are significantly different ($p<0.05$), Upper case letters for rows and lower-case letters for columns.

Formula (1) = 1% Ginger Formula (2) = 3% Ginger Formula (3) = 3% Ginger
Formula (4) = 1.5% Marjoram Formula (5) = 2.5% Marjoram Formula (6) = 3.5% Marjoram

b) Thiobarbituric acid (TBA) value of chicken burgers:

Thiobarbituric acid (TBA) value is the measure of oxidative rancidity in food and is expressed as a value or number (as mg of malondialdehyde per kg). Lipid oxidation in food systems including meat products is the reason behind the formation of off-flavors and off-odors. TBA test gives a direct evaluation of lipid oxidation in meat products and the sensory evaluation is strongly related to it. According to **The Egyptian Organization for Standardization and Quality (EOSQC)-(2005)**, TBA might not exceed 0.9 mg malonaldehyde/kg.

Table (7): Mean value Thiobarbituric acid (TBA) of chicken burgers treated with different levels of herbs powder during storage at 4 ±1ºC for 14 days:-

Days	Control	Chicken Burger samples					
		Ginger			Marjoram		
		Formula 1	Formula 2	Formula 3	Formula 4	Formula 5	Formula 6
1st day	0.392ad	0.400abc	0.401abc	0.400abc	0.380cc	0.379cc	0.379ac
4th day	0.678 ac	0.495cbc	0.493cbc	0.492cbc	0.480cbc	0.477ccbc	0.475cbc
8th day	1.250ab	0.622bb	0.620 bb	0.618 bb	0.614 bb	0.612bb	0.610 bb
14th day	1.568aa	0.938ba	0.936ba	0.934ba	0.908ba	0.906ba	0.906ba

Means in the same column followed by different letters are significantly different ($p<0.05$), Upper case letters for rows and lower-case letters for columns.

Formula (1) = 1% Ginger Formula (2) = 3% Ginger Formula (3) = 3% Ginger
Formula (4) = 1.5% Marjoram Formula (5) = 2.5% Marjoram Formula (6) = 3.5% Marjoram

From these results it was noticed that there weren't significant differences ($p<0.05$) between all chicken burger treatment with herbs and control sample immediately after processing at the first day. On 4th, 8th and 14th days, the lowest TBA value was obtained in chicken burger treated with marjoram levels at (1.5%, 2.5% and 3.5%), than chicken burger treated with ginger levels at (1 %, 2% and 3%) TBA while the highest values were recorded to control sample. The high TBA value in all samples it might be because of the increased lipid oxidation and production of volatile metabolites in the presence of oxygen during preparation and storage as well as during aerobic packaging **(Goli *et al.*, 2005).** It was noticed that as the levels of herbs increases, the TBA value decreases compared to control sample. These results support the previous results reported by **Soltanizadeh** and **Ghiasi-Esfahani, (2015).** the lower values of TBA values in the treated burgers with (marjoram) may be attributed to the antioxidative effect of the herbs, especially due to its high phenolic contents which have the ability to scavenge free radicals, thereby reducing the rate of lipid oxidation**(El-Wakf *et al.*, 2020)**.

6. Microbiological analysis

Meat products (chicken burgers) are as a major vehicle of most reported food poisoning outbreaks. Therefore, it is important to use the microbiological standards because they give guidance on the acceptability of meat products and their manufacturing, handling and distribution processes.

a) Total bacterial count (log cfu/g) of chicken burgers:

Data in Table (8), showed that addition of ginger and marjoram decreased Total bacterial count and slowed down the growth during the storage period in parallel to increasing the concentration, compared to control sample.

Table (8): Total bacterial count (log cfa/g) of chicken burgers treated with different levels of herbs powder during storage at 4 ±1ºC for 14 days:-

Days	Chicken Burger samples						
	Control	Ginger			Marjoram		
		Formula 1	Formula 2	Formula 3	Formula 4	Formula 5	Formula 6
1st day	3.72ad	3.74ac	3.73ac	3.73ac	3.72ad	3.72ac	3.72ac
4th day	6.85ac	6.02abc	5.85abc	5.74abc	5.71ac	5.65bbc	5.10bbc
8th day	8.20ab	6.95bb	6.80bb	6.74bb	6.88bb	6.40bb	6.10bb
14th day	9.96aa	9.14aa	8.44ba	8.11ba	8.38ba	7.78ca	7.25ca

Means in the same column followed by different letters are significantly different ($p<0.05$), Upper case letters for rows and lower-case letters for columns

Formula (1) = 1% Ginger Formula (2) = 3% Ginger Formula (3) = 3% Ginger
Formula (4) = 1.5% Marjoram Formula (5) = 2.5% Marjoram Formula (6) = 3.5% Marjoram

It was noticed on the first day of the storage period at (4±1ºC), the results of the treated samples and untreated (control) sample were close.

On 4th , 8th and 14th days, The total bacterial counts of the prepared burgers were gradually increased, On the contrary, the lowest value for total bacterial counts was in the samples containing marjoram at levels (1.5%, 2.5% and 3.5%) than ginger samples (1%,2%and 3%). marjoram showed a strong inhibitory

effect on this microbial growth. The effectiveness of inhibitiories followed the sequence: Marjoram and ginger. Such results are in agreement (**Mohamed *et al.*, 2011)** and **(Dauqan** and **Abdullah, 2017).** the marjoram was more effective in reducing total bacterial counts compared control, this is related to the high content of phenolic content, where **(Sousa *et al.*, 2006)** and **(El-Wakf *et al.*, 2020) .**those reported that foods rich in polyphenols relate with a wide range of biological properties such as antimicrobial activity.

b)Mold and yeast count

Total yeast and mold count (TYMC) is used as an indicator on the overall cleanliness of a product's life cycle, from growth, processing, handling and storage. A product with high TYMC can be harmful to both consumers and farmers **(Mahmuod** and **Bader, 2011).**

Table (9): Mold and yeast count (1ogcfa/g) of chicken burgers treated with different levels of herbs powder during storage at 4 ±1ºC for 14 days:-

Days	Chicken Burger samples						
	Control	Ginger			Marjoram		
		Formula 1	Formula 2	Formula 3	Formula 4	Formula 5	Formula 6
1st day	2.69ad	2.70ac	2.71ac	2.71ac	2.70ab	2.71ac	2.70ac
4th day	4.35ac	3.64bb	3.60bb	3.45cd	4.15aa	3.71bb	3.60bb
8th day	5.65ab	4.89ba	3.68cb	3.61cb	4.94aa	3.88bb	3.85bb
14th day	6.66aa	5.11ba	4.87ca	4.71ca	5.77ba	4.89ca	4.86ca

Means in the same column followed by different letters are significantly different ($p<0.05$), Upper case letters for rows and lower-case letters for columns

Formula (1) = 1% Ginger Formula (2) = 3% Ginger Formula (3) = 3% Ginger
Formula (4) = 1.5% Marjoram Formula (5) = 2.5% Marjoram Formula (6) = 3.5% Marjoram

Data in table (9) showed that addition of ginger and marjoram decreased Total yeast and mold count and slowed down the growth during the storage period compared to control sample.

On the first day of storage, the values of Mold and yeast count in the samples treated with herbs and the untreated sample (control) were similar in the range of (2.69 - 2.70 - 2.7 11og/g).

On the 4th ,the 8th and 14th day of the storage period at 4 ±1°C, it was noted that the samples containing ginger still had the lowest value in the Mold and yeast count compared to the other samples, followed by the samples containing marjoram. While the control sample continued to increase (5.65 to 6.66 1og/g) and the rate was greater than the treated samples the result with agree with **Hussein *et al.*, (2015).** Used ginger in the burger formulas had effective as antimicrobial due to phenolic compounds in ginger (**Indiarto** and **Rezaharsamto, 2020a).**

7. Sensory evaluation:

Table (10), showed the results of sensory evaluation of chicken burger samples.

Table (10): Mean value of sensory characteristics of chicken burgers treated with different levels of herbs powder Level of significant is (p<0.05).

Characteristics	Chicken Burger samples							
	Control	Ginger			Marjoram			SD
		Formula 1	Formula 2	Formula 3	Formula 4	Formula 5	Formula 6	
Taste	3.1ef	3.1ef	4.25ab	4.75a	3.8bcd	3.75bcde	3.6cdef	0.397
Oder	3.1fg	4.05abcd	4.5a	4.3abc	3.65cdef	3.50def	4.05abcd	0.435
Color	3.25ef	4.55ab	4.85a	4.6ab	3.8cde	3.45def	3.40ef	0.394
Texture	3.35c	4.0ab	4.3a	4.4a	3.6bc	3.3cd	3.2cd	0.400
Juiciness	3.2cd	3.9b	4.7a	4.6a	3.65bc	3.25bcd	3.1cd	0.400
Appearance	3.1fg	4.0ba	4.7a	4.2ab	3.7bcdef	3.55cdef	3.35defg	0.383
Overall acceptability	3.3d	4.00abc	4.4a	4.15ab	3.55bcd	3.25de	3.25de	0.475

*Level of significant is (p< 0.05).

Means in the same column followed by different letters are significantly different (p<0.05), Upper case letters for rows and lower-case letters for columns.

Formula (1) = 1% Ginger Formula (2) = 3% Ginger Formula (3) = 3% Ginger

Formula (4) = 1.5% Marjoram Formula (5) = 2.5% Marjoram Formula (6) = 3.5% Marjoram

When comparing each of the two herbs with the control sample, it was found that the samples containing the 2% ginger and (1.5%) marjoram were better in all characteristics for the tasters, as these herbs were sharp in the chicken burger, and as for the ginger herb, it was the best in all characteristics for the tasters. But sample containing the (2%) ginger is more acceptable in most characteristics than the other levels the sample containing

1% ginger is weakling in taste in addition to the sample containing 3% ginger was unaccepted This is because of the taste was more pungent. On the other hand, when comparing samples containing marjoram the best level was 1% and when compared with control sample there were no significant different but the other samples (2.5%, 3.5% marjoram) were little acceptable for consumer because of, The marjoram was overpowering the taste of the meat and the colour was different than usual, but the texture was good. This result is similar with **(Darwish *et al.*, 2012) ;(Abdel-Naeem** and **Mohamed, 2016)** and **(Mancini *et al.*, 2017).** Ginger showed up the best one for attained the highest sensory acceptance, which makes it the spice of choice to be used as a natural additive in the elaboration of chicken burgers **(Mancini *et al.*, 2017).**

7. Chemical composition of chicken burgers:

Data in table (11) showed that the chemical composition of control sample and chicken burger samples treated with the best level of herbs.

The value of protein content among treated chicken burger samples with different additive of herbs (The sample containing 2% ginger) was The highest in protein content (16.28%) , while protein content in (The sample containing 1.5% marjoram) was(16.14%), compared to control sample (15.42%) .

Table (11): Gross chemical composition (%) presented the best samples of chicken burgers treated with different levels of herbs powder and control samples.

Chemical Composition (%)	chicken burgers samples		
	Control	Formula 2	Formula 4
Protein	15.42	16.28	16.14
Fat	12.85	11.14	11.43
Carbohydrate	7.12	6.56	6.22
Moisture	62.56	63.78	63.70
Ash	2.05	2.24	2.51
Fiber	1.17	11.22	4.54

Formula (2) containing 2% Ginger Formula (4) containing 1.5% Marjoram

As for fat content among samples with different additive of herbs The highest value for fat content was The control sample (12.85%), than The sample containing 1.5% marjoram (11.43%), than The sample containing 2% ginger (11.14%) . Moreover Ash content among samples with different additive of herbs (The sample containing1.5% marjoram) was a highest value for ash content than the other samples (2.51%), while Ash content in the sample containing 2% ginger herb (2.24%) followed by The control sample (2.05%) .

In addition to the moisture content in the samples, the moisture content in the control sample (62.56%) was lower than other samples, and the highest value was for the sample containing 2% ginger (63.78%), then the sample containing 1.5% marjoram(63.70%),But, it was found that the highest fibre content was in the sample containing 2% ginger (11.22%), than the sample containing 1.5% marjoram (4.54%), and the lowest fiber content was in the control sample (1.17%).

Conclusion:

This study concluded that the addition of the herbs (ginger and marjoram) in the formulations (at 2% and 1 .5%, respectively) reduced the microbial counts and slowed the lipid oxidation of the chicken burgers. Moreover, the burgers made with ginger had the highest rates of sensory acceptance.

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