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EFFECT OF COOKING METHODS ON ORGANOLEPTIC AND MICROBIOLOGICAL PROPERTIES OF LOW-FAT BEEFBURGER WITH ADDED OAT AS FAT-REPLACER

Morsi, M. K.; Haiam, M. Ibrahim*; S. M. Galal** and Mona, A. Ibrahim***

*** Food Techhnology Dept. National Res. Center, Dokki, Cairo, Egypt.**

**** Food Technology Dept. Fac. of Agric. Cairo University.**

ABSTRACT

The present study was carried out to produce low-fat beef burger using oat at 1.5, 2.5 and 4%as fat-replacer and some natural additives to improve flavor and as preservative materials. Thyme (0.75%), rosemary (0.75 %) and mixture of thyme (0.375 %) + rosemary (0.375 %) were added to the suggested low-fat beef burger formulae. A control sample without any of these additives was used. All samples were stored at -20° C for three months. At zero time and during storage period, burger samples were subjected to one of the following cooking methods: a) Grilling of raw burger. b) Grilling of partially cooked (by microwave) burger. Organoleptic as well as microbiological tests were performed. Results showed that the presence of oat at 2.5% improved tenderness, texture, chewing and overall-acceptability of the investigated samples. Thyme in the micro waved-grilled beef burger samples showed significant deterioration in chewing and overall-acceptability. Grilling or Microwave cooking of burger followed by grilling caused sharp decrease in total microbial count and complete elimination of *E. coli* and *St. aureus*. During frozen storage, samples with thyme contained lower microbial counts than those samples containing mixture of thyme and rosemary.

Keywords: Low-fat beef burger; Oat; Natural additives; Organoleptic, Microbiological properties..

INTRODUCTION

Proper nutrition and anxiety over fatty foods are the major factors influencing consumer food choices today. A large part of the consumer food budget is spent in meat and meat products e.g. beef burger, sausage…etc; (Kuntson 1991), which contain 20 % fat. A surge of intense competition among meat processors to provide consumers with low-fat meat products has demanded product development efforts in this area in recent years.Therefore, much research work on development of low fat meat products has centered on the production of the low fat meat products. The impetus of research into low-fat meat products is primarily due to consumer. The low-fat meat products have generated a variety of strategies for reducing fat, but the final goal has been to reduce fat while retaining traditional full fat flavor and texture.

Recommendations such as those of the American Heart Association to reduce dietary fat intake to lower serum cholesterol levels may have led to an increase in the consumption of low fat ground beef : the major problem in acceptability of low fat processed meat products is the decline in palatability that accompanies the reduction in fat content.

The desirable sensory characteristics of meat product are juiciness and mouthfeel (Giese 1992). Reduction or removal of fat from meat products requires a fat-replacer and various ingredients e.g. flavoring and seasoning that can provide mouthfeel, texture and flavor of fat in the finished product.

Oat fiber is one of other ingredients performed best as fat substitutes, and their blends can be used to offset the poor quality associated with low-fat beef burger (Paul et al. 1999). Oat has been also used to decrease cooking loss and improve palatability (Desmond et al. 1998). Oat contains nonstarchy polysaccharides, β-glucan, in endosperm cell walls in concentrations between 2.2 and 2.4 % (Aman and Graham 1987). It is the major soluble fiber found in oat, it has the ability to lower blood cholesterol level with decreases in serum low-density lipoprotein (LDL) concentrations and increases in high density lipoprotein (HDL) cholesterol concentrations (Chen and Anderson 1979). Thyme and rosemary were added to the product to give taste , improve flavor and also as preservative materials.(El-Baroty 1988).

The wide spread use of frozen meat for processing meat products has considerable importance for the industry. Dreeling et al.2000 frozen lean and fat meat at -23°C for 1-3 week prior to mincing, to simulate commercial practice,before preparing low–fat beefburger.

Since most meat products in Egypt are made from imported frozen meat,in the present study, fresh meat cuts were frozen for 2 months before preparation of meat burger.

Several challenges have to be faced as reported by Donald (1991) :

1- The finished products should have a desirable taste.
2- The product must be 90% fat free
3- The product has to offer low calories and cholesterol.
4- The product should offer great yield after cooking.

The objective of this work is to prepare low fat burger, using Oat as fat-replacer to improve palatability besides, thyme, rosemary and their mixture were used to improve flavor and also as preservative materials.

Low-fat beef burger samples were organoleptically and microbiologicaly evaluated after the processing and during the storage period.

MATERIALS AND METHODS

Meat:

Fresh lean beef (top round) muscle of old cow (age 3 years) were obtained from the slaughter house,Cairo,Egypt in November 2003. External fat and connective tissues were manually trimmed. The lean beef were frozen at – 20°C for two months prior to mincing to simulate commercial practice. The frozen lean beef were minced using meat mincer (Home mincer) and comminuted meat was used for processing of low–fat beef burger.

Oat :

Whole flaked oat(*Avena Sativa*) seeds [Product of Australian white Oats (UNCLE TOBYS)] were obtained from local market and grined to powder using a mill then used as a fat-replacer for preparing low- fat beef burger to improve palatability.

Thyme and Rosemary:

Thyme *(Thumus vulagris L.)* and rosemary *Rosemarinus officinalis L.*) in dry form were purchased form local market and grinded in a mill and used for preparing low-fat beef burger to improve flavor and as preservative materials.

Spices:

Spice mixture was prepared using equal weights of clove, black pepper, Chinese cubeb, paprika and nutmeg. All were obtaind from local market.

Salt,onion,garlic and parsley :

Salt ,fresh onion,garlic and parsley were obtained from local market and used for preparation o f beef burger.

Microorganisms:

Staphylococcus aureus and *Escherichia coli* were obtained from Microbiology Department,Faculty of Agriculture,Cairo University, Egypt. These microorganisms were checked for purity and identity and always regenerated to obtain active microorganisms as described in Difco (1984).

Media:

Plate Count Agar, MacConkey Agar, Barid Parker media were prepared according to Difco (1984) for determination of total bacterial count, *coliform group* and *Staphylococcus aureus* ; respectively. Tryptos Soy broth was also prepared according to Difco (1984) for cultivation *E. coli* and *St.aureus* then inoclulation of minced meat and beefburger.

Burger Processing :

Choosing Oat Ratio:

The following tabulated low-fat beef burger formulae Table (1) were prepared with adding different oat ratios, to choose the suitable ratio.

Table (1): Low-fat beef burger formulae with different ratios of oat

Ingredients	Oat 1.5 %	Oat 2.5 %	Oat 4 %	Control
Ground frozen meat	84.25	83.25	81.75	85.75
Oat	1.50	2.50	4.00	—
Salt	1.00	1.00	1.00	1.00
Onion	0.50	0.50	0.50	0.50
Garlic	0.25	0.25	0.25	0.25
Parsley	0.25	0.25	0.25	0.25
Mixed spices	0.25	0.25	0.25	0.25
Iced water	12.00	12.00	12.00	12.00

Low-fat beef burger formulae with different ratios of oat and control samples were cooked by two different methods

1-Grilling for 2.5 min at each side in a non sticky pan with no added fat .

2-Partial cooking in microwave (Goldstar ER-535 MD, input 220v-50Hz, frequency 2450MHz having a maximal energy of 0.98 kw 100 % power) for 1 min at each side then grilled in a non sticky pan with no added fat for additional 1.5 min at each side to complete cooking .

Organoleptic evaluation was carried out immediately after cooking. Low-fat beef burger containing 2.5% oat gained the highest organoleptic score (see Table 5), so all investigated burger samples were formulated using 2.5% oat as fat- replacer.

Preparation of beef burger samples:

Low-fat beef burger formulae A,A1,A2 and A3 Table (2) were prepared by mixing well the ground frozen meat with the optimal oat ratio (2.5%), thyme and rosemary with different ratios and the other ingredients. The burger formulae were formed using burger form. After processing each formula, the beef burger samples were packaged in polyethelene bags and were stored at -20 °C until required .

Table (2): formulae of investigated beef burger samples (g).

ingredients	A	A1	A2	A3
Ground frozen meat	83.25	82.50	82.50	82.50
Oat	2.50	2.50	2.50	2.50
Salt	1.00	1.00	1.00	1.00
Onion	0.50	0.50	0.50	0.50
Garlic	0.25	0.25	0.25	0.25
Parsley	0.25	0.25	0.25	0.25
Mixed spices	0.25	0.25	0.25	0.25
Thyme	0.00	0.75	0.00	0.375
Rosemary	0.00	0.00	0.75	0.375
Iced water	12.00	12.00	12.00	12.00
Total	100	100	100	100

A = control
A1 = beef burger sample containing 0.75% thyme
A2 = beef burger sample containing 0.75% rosemary
A3 = beef burger sample containing 0.375% thyme + 0.375% rosemary

Prepared low fat beef burger samples of all formulae A,A1,A2 and A3 were divided into two groups. First group was stored immediately after preparation at -20°C in a deep freezer for up to three months where samples were withdrawn monthly for cooking, analyses and evaluation. Second group of burger was partially cooked in microwave (under conditions mentioned before) for 1 min at each side then frozen for up to three months at -20°C and samples were withdrawn monthly for complete cooking, analyses and evaluation.

Cooking Of Beefburger

The low-fat beef burger samples under investigation, immediately after preparation (zero time storage) and during storage were subjected to one of the following cooking methods :

a) Grilling of raw burger

Burger samples were grilled on electrical heater in a non sticky pan with no added fat, for 2.5 min at each side.

b) Grilling of partially cooked (by microwave) burger

Burger samples that were subjected to partial cooking by microwave before frozen storage were completely cooked by grilling in a non sticky pan with no added fat for 1.5 min. additionally at each side.

Chemical analyses

Moisture, fat, protein and ash were determined in meat, oat, thyme and rosemary according to official methods (A.O.A.C. 2000). Nitrogen free extract (N.F.E.) was calculated by difference. Total soluble nitrogen (T.S.N.) and soluble protein nitrogen (S.P.N.) were determined according to the methods reported by EL-Gharabawi and Dugan (1965.). Total volatile nitrogen (T.V.N) was determined according to Malle and Tao (1987) and thiobarbituric acid value (T.B.A.) was determined according to Lemon (1975).

Organoleptic Examinations

Cooked beef burger samples were evaluated organoleptically immediately after cooking (zero time analysis) and after 1, 2 and 3 months of frozen storage at -20 ^{o}C.

Sensory quality attributes included color, chewing, taste, flavor, appearance, texture and overall acceptability.

Cooked burger samples were served just after cooking to 10 staff members in Food Technology Department, National Research Center. A 10 – point hedonic scale (1 being dislike very much to 10 being like very much) was used to evaluate the sensory attributes of burger samples according to Gelman and Benjamin (1989).

Statistical Analyses

The statistical analysis of data obtained from the sensory evaluation for each individual parameter of all samples during the whole storage period (4 treatments & 4 durations) was carried out by analysis of variance (ANOV) and least significant different (L.S.D.) at the 5% level of probability as reported by Snedecor and Cochran (1980).

Microbiological Examinations

The microbiological examination of the prepared burger samples included determination of total bacterial count, *coli form* group and *staphylococcus aureus.*

Samples Preparation

Ten grams of representative burger samples were mixed with 90 ml. of sterile saline solution (9 gm NaCl / 1L distilled water) in a blender, under aseptic conditions, to give 1 / 10 dilution. Serial dilutions were prepared to be used for counting total bacteria, *coli form* group and *Staph. aureus* bacteria as outlined by Difco (1984).

Total Bacterial Count:

Total bacterial count was determined using Plate Count Agar medium according to the procedure described by Difco (1984). The plates were incubated at 37°C for 48 h.

***Coliform* Group:**

Coli form group was determined using MacConkey Agar medium according to the method described by Difco (1984). The plates were incubated at 37°C for 24 h .

***Staphylococcus Aureus* Count:**

The *St. aureus* bacterial count was determined according to the method described by Difco 1984 using Barid Barker medium plus 1 ml potassium tellurite solution 1% (w / v) to each 100 ml of the sterilized medium. The prepared medium was mixed well before pouring in the plates. The plates were incubated at 37°C for 48 h.

Effect Of Microwave Treatment On Low-Fat Minced Meat And Low-Fat Beef Burger Samples Inoculated With *E.Coli* And *St.Aureus*

Low-fat minced meat sample inoculated with *E.Coli* to 1.8×10^7 cfu/g and with *St.aureus* to 7.0×10^5 cfu/g and low-fat beef burger sample inoculated with *E.Coli* to 1.5×10^7 cfu/g and with *St.aureus* to 1.1×10^6 cfu/g were subjected to microwave treatment (maximum energy of 0.98 kw 100% power) for 2 min. (partial cooking) and 4 min. (complete cooking) and counts were determined after these treatments .

RESULTS AND DISCUSSION

Chemical composition of raw meat (frozen at -20 °C for two months) is given in Table (3). Results showed that total lipids content in the frozen meat (low-fat meat) muscle was only 1.82 % on fresh wt. basis (equal to 6.53 % on dry wt. basis) indicating the efficiency of the manual defatting of the muscle. EL Naggar (1999) found that total lipids in imported beef was 2.13 % on fresh wt. basis, represented 8.85 % on dry wt. basis.

Table (3) : Chemical composition of frozen meat (lean beef).

parameters	On fresh wt basis
Moisture %	72.13
Fat %	1.82
Protein (N X 6.25) %	23.40
Ash %	0.97
NFE %	1.68
T.S.N. %	0.67
S.P.N. %	0.40
N.P.N. %	0.27
T.V.N.	13.38
T.B.A.	0.14

T.V.N. mg N / 100 gm sample **T.B.A. mg malonaldehyde / kg sample**

Total soluble nitrogen, soluble protein nitrogen, total volatile nitrogen and thiobarbituric acid were within the limits for the constituent in beef meat. Results in Table (4) showed that oat chemical composition was within the values reported by Abo EL Naga (2002).Thyme and rosemary chemical composition were also within values reported by Farrell (1999) .

Table (4) : Chemical composition of oat, thyme and rosemary (on fresh wt. basis)

Parameter. / Sample	Moisture %	Fat %	Protein %	Ash %	NFE %
Oat	12.80	7.22	12.30	3.20	64.48
Thyme	10.15	5.27	8.18	11.40	65.00
Rosemary	8.53	7.31	4.48	8.03	71.65

NFE= Nitrogen Free extract

Effect Of Oat On Organoleptic Properties Of Low-Fat Beefburger

Low-fat burger is known to be tough (Egbert et al. 1991) and oat is added to improve its properties. In the present study, Oat was used in the preparation of low-fat burger at 1.5, 2.5 and 4 % as fat-replacer and the burger was prepared from meat frozen for 2 months. Organoleptic properties of the investigated cooked low-fat beef burger samples either grilled or partially cooked by microwave followed by grilling were evaluated in comparison with no oat burger (control) sample in Tables (5,6).

Table (5) : Organoleptic evaluation of grilled low-fat beef burger Formula using oat with different ratios

Parameters		Oat			control
		1.5 %	2.5 %	4 %	
Color	Ns	7.4	7.4	7.0	7.1
Chewing	Ns	6.7	7.4	7.3	6.0
Tenderness	**	7.2 b	7.7 ab	7.7 ab	6.0 c
Flavor	Ns	7.2	7.3	7.7	6.9
Appearance	Ns	6.8	7.2	7.4	7.1
Texture	**	7.0 bc	7.8 a	7.5 ab	6.5 c
Overall acceptabilit	**	7.05 ab	7.46 a	7.43 a	6.60 b

- **Means with the same letter in the same row are not significantly different at 0.05 level of significance.**
- **Control = with no added oat.**

Table (6): Organoleptic evaluation of micro waved-grilled low-fat beef burger formula using oat with different ratios

Parameters		Oat			control
		1.5 %	2.5 %	4 %	
Color	ns	7.5	7.0	6.6	7.5
Chewing	**	8.0 ab	8.8 a	7.6 b	5.2 c
Tenderness	**	8.0 a	8.8 a	8.2 a	5.9 b
Flavor	**	8.0 ab	8.4 a	7.4 bc	6.2 c
Appearance	**	7.8 ab	8.2 a	7.2 b	6.6 c
Texture	ns	7.6	8.0	6.8	6.6
Overall acceptability	**	7.8 ab	8.2 a	7.3 b	6.3 c

- **Means with the same letter in the same row are not significantly different at 0.05 level of significance.**
- **Control = with no added oat.**

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Results in Table (5) showed that presence of oat in grilled burger improved organolepticaly tenderness, texture and overall acceptability (when oat was used at > 1.5 %). With regard to micro waved-grilled burger results in Table (6) showed that oat significantly improved chewing, tenderness, flavor and overall acceptability (in case of 1.5, 2.5 % oat only). Therefore, all low-fat burger samples used in this study were formulated using 2.5 % oat that yielded highest organoleptic score, especially in micro waved-grilled burger samples. Pual et al. (1999) reported that beef burger containing pectin, micro-crystalline cellulose, oat fiber or carrageenan, scored high in flavor and overall acceptability.

Effect Of Additives And Storage Period On Organoleptic Properties Of Grilled And Micro Waved – Grilled Low- Fat Beef Burger

Low-fat beef burger contained oat and the additives either thyme or rosemary or their mixture were frozen up to 3 months at -20°C. The tested burger samples were withdrawn monthly, cooked and organolepticaly evaluated. Results in Tables (7, 8) showed that there was gradual, but insignificant decrease in almost all measured parameters compared to control (additive free sample).

Presence of thyme in micro waved-grilled burgers caused significant deterioration in chewing and overall acceptability compared to control sample at zero time.

Results indicated that although organoleptic properties deteriorated during frozen storage there were no significant differences between samples with additives and control sample after same storage period.

Effect Of Additives On Microbial Count Of Low-Fat Beefburger

Effect of thyme, rosemary and their mixture on microbial count of frozen low-fat beef burger samples are shown in Table (9).

Table (9) : Total bacterial count , *E.coli* and *St.aureus* of frozen low-fat beef burger samples

parameters	Storage period (months)	/ gm			
		A	A1	A2	A3
T.B.C.	٠	7.9×10^4	7.3×10^4	7.4×10^4	7.5×10^4
	١	6.3×10^4	5.0×10^4	5.8×10^4	5.4×10^4
	٢	5.2×10^4	3.4×10^4	5.5×10^4	4.5×10^4
	٣	5.0×10^4	2.8×10^4	5.1×10^4	4.0×10^4
E.coli	٠	9.5 x 10	8.0 x 10	8.5 x 10	8.0 x 10
	١	8.5 x 10	6.5 x 10	7.5 x 10	7.0 x 10
	٢	7.5 x 10	5.0 x 10	6.5 x 10	5.5 x 10
	٣	7.0 x 10	4.5 x 10	6.0 x 10	5.0 x 10
St.aureus	٠	9.0 x 10	7.5 x 10	8.0 x 10	7.5 x 10
	١	8.0 x 10	5.5 x 10	6.5 x 10	6.5 x 10
	٢	7.5 x 10	5.0 x 10	6.5 x 10	5.5 x 10
	٣	7.0 x 10	4.0 x 10	5.5 x 10	4.5 x 10

T.B.C. = total bacterial count
A = control
A1 = beef burger sample containing 0.75% thyme
A2 = beef burger sample containing 0.75% rosemary
A3 = beef burger sample containing 0.375% thyme + 0.375% rosemary
C.F.U.= colony forming unit.

Table (10): Total bacterial count, *E .coli* and *St. aureus* in frozen and grilled low-fat beef burger samples.

parameters	Storage period (months)	Cfu / gm			
		A	A1	A2	A3
T B. C.	0*	7.9×10^4	7.3×10^4	7.4×10^4	7.5×10^4
	0**	6.0×10^2	5.3×10^2	5.5×10^2	5.7×10^2
	1*	6.3×10^4	5.0×10^4	5.8×10^4	5.4×10^4
	1**	4.4×10^2	3.2×10^2	4.0×10^2	3.6×10^2
	2*	5.2×10^4	3.4×10^4	5.5×10^4	4.5×10^4
	2**	3.4×10^2	1.7×10^2	3.6×10^2	2.8×10^2
	3*	5.0×10^4	2.8×10^4	5.1×10^4	4.0×10^4
	3**	3.1×10^2	1.0×10^2	3.2×10^2	2.1×10^2
E.coli	0*	9.5 x 10	8.0 x 10	8.5 x 10	8.0 x 10
	0**	Nil	Nil	Nil	Nil
	1*	8.5 x 10	6.5 x 10	7.5 x 10	7.0 x 10
	1**	Nil	Nil	Nil	Nil
	2*	7.5 x 10	5.0 x 10	6.5 x 10	5.5 x 10
	2**	Nil	Nil	Nil	Nil
	3*	7.0 x 10	4.5 x 10	6.0 x 10	5.0 x 10
	3**	Nil	Nil	Nil	Nil
St.aureus	0*	9.0 x 10	7.5 x 10	8.0 x 10	7.5 x 10
	0**	Nil	Nil	Nil	Nil
	1*	8.0 x 10	5.5 x 10	6.5 x 10	6.5 x 10
	1**	Nil	Nil	Nil	Nil
	2*	7.5 x 10	5.0 x 10	6.5 x 10	5.5 x 10
	2**	Nil	Nil	Nil	Nil
	3*	7.0 x 10	4.0 x 10	5.5 x 10	4.5 x 10
	3**	Nil	Nil	Nil	Nil

T.B.C. = total bacterial count
*** = total bacterial count, E. coli and St. aureus at frozen state before cooking**
**** = total bacterial count, E. coli and St. aureus at frozen state after cooking**
A = control
A1 = beef burger sample containing 0.75% thyme
A2 = beef burger sample containing 0.75% rosemary
A3 = beef burger sample containing 0.375% thyme + 0.375% rosemary
C.F.U.= colony forming unit.

Effect of microwave treatment on low-fat minced meat and low-fat beef burger samples inoculated with *e. Coli* and *st. Aureus:*

Effect of microwave treatment of low-fat minced meat and low-fat beef burger on *E. coli* and *St. aureus* is shown in Table (12). Results showed that raw burger prepared from frozen low-fat meat contained high levels of *St. aureus* than minced meat, while both samples contained constant count of *E. coli*.

Subjecting minced meat or burger to full time cooking (4 min.) caused complete elimination of both *St. aureus* and *E. coli*, while subjecting both samples to partial cooking by microwave (2 min.) caused sharp reduction of both *E. coli* and *St. aureus* in minced meat. The same treatment (2 min. in microwave) caused complete elimination of *E. coli* and removed almost 99 % of *St. aureus* in burger sample. These results showed the high efficiency of microwave for killing microorganisms.

Table (11): Total bacterial count, *E. coli* and *St. aureus* in frozen and micro waved - grilled beef burger samples.

parameters	Storage period (months)	Cfu / gm			
		A	A1	A2	A 3
T.B.C.	0*	7.9×10^4	7.3×10^4	7.4×10^4	7.5×10^4
	0**	5.8 x 10	5.2 x 10	5.4 x 10	5.4 x 10
	1*	6.3×10^4	5.0×10^4	5.8×10^4	5.4×10^4
	1**	4.3 x 10	3.0 x 10	3.9 x 10	3.4 x 10
	2*	5.2×10^4	3.4×10^4	5.5×10^4	4.5×10^4
	2**	3.3 x 10	1.5 x 10	3.6 x 10	2.6 x 10
	3*	5.0×10^4	2.8×10^4	5.1×10^4	4.0×10^4
	3**	3.0 x 10	0.8 x 10	3.1 x 10	2.0 x 10
E.coli	0*	9.5 x 10	8.0 x 10	8.5 x 10	8.0 x 10
	0**	Nil	Nil	Nil	Nil
	1*	8.5 x 10	6.5 x 10	7.5 x 10	7.0 x 10
	1**	Nil	Nil	Nil	Nil
	2*	7.5 x 10	5.0 x 10	6.5 x 10	5.5 x 10
	2**	Nil	Nil	Nil	Nil
	3*	7.0 x 10	4.5 x 10	6.0 x 10	5.0 x 10
	3**	Nil	Nil	Nil	Nil
St.aureus	0*	9.0 x 10	7.5 x 10	8.0 x 10	7.5 x 10
	0**	Nil	Nil	Nil	Nil
	1*	8.0 x 10	5.5 x 10	6.5 x 10	6.5 x 10
	1**	Nil	Nil	Nil	Nil
	2*	7.5 x 10	5.0 x 10	6.5 x 10	5.5 x 10
	2**	Nil	Nil	Nil	Nil
	3*	7.0 x 10	4.0 x 10	5.5 x 10	4.5 x 10
	3**	Nil	Nil	Nil	Nil

T.B.C. = total bacterial count
*** = total bacterial count,E.coli and St.aureus at frozen state before cooking**
**** = total bacterial count,E.coli and St.aureus at frozen state after cooking**
A = control
A1 = beef burger sample containing 0.75% thyme
A2 = beef burger sample containing 0.75% rosemary
A3 = beef burger sample containing 0.375% thyme + 0.375% rosemary
C.F.U. = colony forming unit.

Table (12) : Effect of microwave treatment on microbial count of low-fat meat and burger (C.F.U/g sample).

Microwave treatment / sample	Uncooked (0 min)		Partial cooking (2min)		Complete cooking (4min)	
	E.coli	*St.aureus*	*E.coli*	*St.aureus*	*E.coli*	*St.aureus*
Minced meat	1.8 x 107	7.0 x 105	4.2 x 103	2.0 x 102	Nil	Nil
Beef burger *	1.5 x 107	1.1 x 106	Nil	3.0 x 10	Nil	Nil

C.F.U. = colony forming unit.
*** = basal formula without thyme or rosemary (Table 1) .**

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تأثير طرق الطهي علي الصفات الحسيه و الميكروبيولوجيه لبرجر اللحم المنخفض الدهن المضاف إليه الشوفان كبديل للدهن

محمد خيري مرسي ، هيام محمد إبراهيم*، سامي محمد جلال**و منى أحمد إبراهيم***

*** قسم الصناعات الغذائية - المركز القومي للبحوث – الدقي – الجيزة .**

**** قسم الصناعات الغذائية - كلية الزراعة - جامعة القاهرة.**

أجريت هذه الدراسة بهدف إنتاج بيف برجر منخفض الدهن باستخدام دقيق الشوفان كمصدر لبدائل الدهن بنسبة ١,٥, ٢,٥ , ٤% وكذلك بعض الإضافات الطبيعية كالزعتر أوالحصالبان أومخلوطهما لتحسين نكهة البرجر وحفظه .

تم تجهيز ثلاث معاملات مختلفة من البيف برجر :

المعاملة الأولى تم تجهيزها بإضافة ٠,٧٥ % من مسحوق الزعتر المجفف .

المعاملة الثانية تم تجهيزها بإضافة ٠,٧٥ % من مسحوق الحصالبان المجفف .

المعاملة الثالثة تم تجهيزها بإضافة مخلوط من الزعتر والحصالبان (٠,٣٧٥ % مسحوق زعتر مجفف + ٠,٣٧٥ % مسحوق حصالبان مجفف). كما تم تجهيز عينة مقارنة خالية من الإضافات الطبيعية (مسحوق الزعتر أو مسحوق الحصالبان) وذلك للمقارنة. جميع المعاملات المجهزة سابقا تم تقسيمها لمجموعتين – المجموعة الأولى تم تخزينها مباشرة بالتجميد على(- ٢٠° درجة مئوية) لمده ٣ شهور حيث تم سحب عينة شهريا للطهى والتقييم ، أما المجموعه الثانيه من البيف برجر فتم طهيها جزئيا فى الميكروويف ثم تخزينها بالتجميد على(- ٢٠° درجة مئوية) لمدة ٣ شهور أيضا حيث تم سحب عينه شهريا لاتمام الطهى و التقييم.

تم طهى العينات (سواء بعد التجهيز مباشرة أو خلال التخزين بالتجميد) بإحدى الطريقتين الأتيتين :

١- الطهى بالشى للبيف برجر المجمد .

٢- إتمام الطهى بالشى للبيف برجر المجمد النصف مطهى بالميكروويف.

خلال فترة التخزين بالتجميد على (- ٢٠° درجة مئوية) تم إجراء بعض الإختبارات الحسيه والميكروبيولوجية وذلك بغرض معرفة مدى تقبل المنتج حسيا وكذلك مدى قدره الإضافات الطبيعية على منع حدوث تغيرات بالمنتج أو العمل على تأخيرها . وقد أوضحت النتائج أن إستخدام الشوفان بنسبة ٢,٥% قد حسن من القوام والقابلية للمضغ ودرجة القبول الكلية للعينات محل البحث. العينات المضاف لها زعتر والمطهية جزئيا بالميكروويف قبل إستكمال طهيها بالشى أظهرت تدهورا معنويا فى القابلية للمضغ ومدى التقبل الكلى بالمقارنة بعينة المقارنة. وأشارت النتائج إلى أن طهى العينات بالشى أو تعرضها للميكروويف (لمدة ٢ دقيقة) قبل إستكمال الطهى بالشى قد سبب نقصا حادا فى العد الكلى للميكروبات وإبادة لكلا من ميكروبى *St.aureus , E.coli* فى جميع العينات محل الدراسة ، كما أن التخزين بالتجميد للعينة المحتوية على الزعتر قد صاحبه إنخفاض ملحوظ فى الأعداد الكلية للميكروبات , *E.coli , St.aureus* يليه العينة المحتوية على مخلوط الزعتر والحصا لبان.

Table (7) : Organoleptic evalution of grilled low-fat beefburger

Parameters \ Storage period (months)		A				A1				A2				A3			
		٠	١	٢	٣	٠	١	٢	٣	٠	١	٢	٣	٠	١	٢	٣
Color	ns	7.4	7.1	7.4	7.1	7.5	7.0	7.3	6.5	7.9	7.5	7.5	6.9	7.4	7.0	7.0	6.9
Chewing	*	7.4a	7.2 a	7.2 a	7.2 a	7.2 a	6.7ab	6.3ab	5.7b	7.1a	7.0ab	6.7ab	6.6ab	7.3 a	6.4ab	6.3ab	6.3ab
Taste	**	7.7ab	7.8 a	7.7ab	7.7ab	6.7bc	6.8bc	—	5.8c	7.0abc	7.1abc	7.4abc	7.3abc	7.1abc	6.4bc	6.4 bc	6.4bc
Flavor	**	7.3ab	7.7 a	6.5abc	7.7a	6.5abc	6.5abc	6.4abc	5.4c	7.1ab	6.9 ab	7.1 ab	6.8 ab	7.3 ab	6.8ab	6.4abc	6.3bc
Appearance	ns	٧,٢	٧,٥	٧,٥	٧,٥	٧,٠	٧,٠	٧,٠	٦,٥	٧,٣	٧,٥	٧,٩	٧,٢	٧,٤	٧,٢	٧,٣	٧,٢
Texture	**	7.8 a	6.5abc	7.6 ab	6.5abc	7.4 ab	6.0 bc	6.0 bc	4.9c	7.5ab	6.4abc	7.5 ab	6.4abc	7.1 ab	6.0bc	—	6.6ab
Over all acceptabilit	**	7.46a	7.30ab	7.31ab	7.28ab	7.01abc	6.66bc	6.60bc	5.8c	7.15ab	7.01abc	7.43 a	7.03abc	7.26ab	6.63bc	6.68bc	6.61bc

- **Means with the same letter in the same row are not significantly different at 0.05 level of significance.**

A = control
A1 = beefburger sample containing 0.75% thyme
A2 = beefburger sample containing 0.75% rosemary
A3 = beefburger sample containing 0.375% thyme + 0.375% rosemary
— = not determined

Table (8) :Organoleptic evaluation of microwaved- grilled low-fat beefburger

Parameters \ Storage period (months)		A				A1				A2				A3			
		٠	١	٢	٣	٠	١	٢	٣	٠	١	٢	٣	٠	١	٢	٣
Color	ns	٧,٠	٧,٢	٧,٢	٧,٢	٧,٨	٦,٩	٧,٠	٦,٩	٧,٥	٧,٩	٧,٥	٧,٥	٧,٥	٧,٩	٧,٧	٧,٩
Chewing	*	8.0a	7.3abc	7.9a	7.3abc	7.1bc	6.7c	6.6c	6.5c	7.4ab	7.6 ab	7.3abc	7.6 ab	7.7 ab	7.6 ab	7.3abc	7.3abc
Taste	*	7.9a	7.8ab	7.6 ab	7.4ab	6.5abc	6.5abc	6.7abc	6.2bc	7.3ab	7.1abc	7.3ab	7.6 ab	7.5 ab	6.7abc	7.6 ab	6.8abc
Flavor	*	8.0a	7.0 ab	7.5a	7.0ab	6.9ab	5.9b	5.9b	5.9b	7.5a	7.3ab	7.6a	7.2 ab	7.3 ab	7.4 a	7.6a	7.0ab
Appearance	ns	٨,٢	٨,٠	٧,٩	٦,٧	٧,٧	٧,١	٧,٢	٧,١	٧,٦	٧,٩	٧,٧	٧,٨	٧,٥	٧,٩	٧,٧	٧,٧
Texture	ns	٨,٠	٧,٩	٨,١	٦,٦	٧,٢	٦,١	٦,١	٦,١	٧,٣	٧,٠	٧,٤	٧,٠	٧,٣	٧,٧	٧,٣	٧,٧
Over all acceptabilit.	*	7.85ab	7.53ab	7.70ab	7.03bc	7.20bc	6.53c	6.58c	6.4c	7.43ab	7.46ab	7.46ab	7.45ab	7.46ab	7.53ab	7.53ab	7.40ab

- **Means with the same letter in the same row are not significantly different at 0.05 level of significance.**

A = control
A1 = beefburger sample containing 0.75% thyme
A2 = beefburger sample containing 0.75% rosemary
A3 = beefburger sample containing 0.375% thyme + 0.375% rosemary