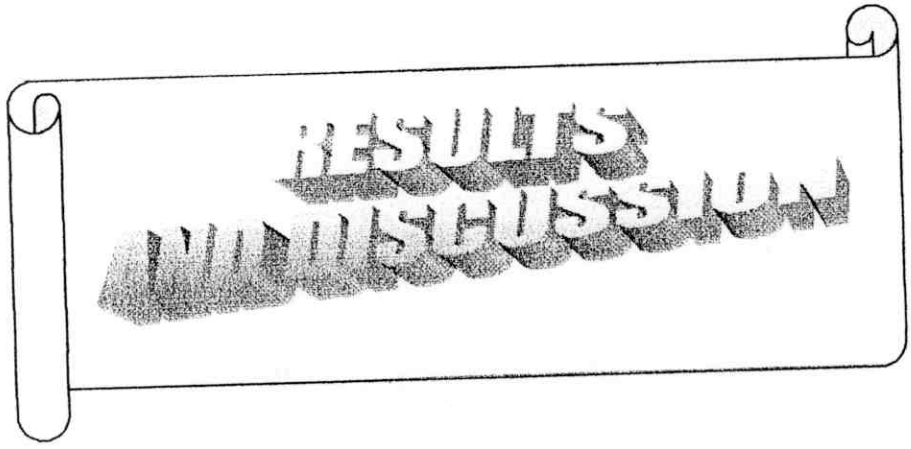

RESULTS
AND DISCUSSION

IV. RESULTS AND DISCUSSION

1. Minced meat:

1.1.Chemical composition:

The gross chemical composition of tempeh, fresh minced meat (control), laboratory minced meat prepared with addition of temeph level and local minced meat are given in Table (1).

The highest moisture content of tempeh was 72.68%. However, laboratory prepared minced meat samples had moisture content ranged from 72.14-72.44%. But, minced meat samples A and B from local market had lower moisture content which were 63.96 and 64.83%, respectively.

Results obtained from moisture content of minced meat samples are in agreement with Marchello *et al.*(1984), El-Akary (1986), Liu *et al.* (1991) El-Moshtohory (1997), and Abd El-Aziz (2000).

Protein content:

The protein content in tempeh was lower (52.12%) than that of raw minced meat (72.67%) (control), So, protein content in the laboratory prepared samples was decreased with increasing tempeh level from 5-25%. While protein content in raw minced meat (control) was 72.64% reached in laboratory sample that contain 25% tempeh to 65.89% on dry weight basis (Fig. 1). On the other hand, protein content in local minced meat samples was lower than all other laboratory prepared samples (54.99%, 58.15%).

Table (1): Chemical composition of tempeh, minced meat prepared in laboratory mixed with tempeh and local minced meat samples (mean ± S.D.).

Sample		Moisture %	Crude protein %		Ether extract %		Ash %		Total carbohydrate %		Energy K cal/g	
			W.W.	D.W.	W.W.	D.W.	W.W.	D.W.	W.W.	D.W.	W.W.	D.W.
Tempeh		72.68 ±0.08	14.24 ±0.07	52.12 ±0.27	1.66 ±0.01	6.08 ±0.04	1.16 ±0.02	4.25 ±0.07	10.26 ±0.03	37.55 ±0.11	114.99 ±0.88	420.90 ±3.22
Minced meat prepared in laboratory mixed with tempeh by	0% control	72.37 ±0.09	20.07 ±0.04	72.64 ±0.13	5.71 ±0.02	20.66 ±0.07	0.98 ±0.01	3.55 ±0.04	0.87 ±0.01	3.15 ±0.04	135.32 ±0.96	489.76 ±3.48
	5%	72.28 ±0.09	19.82 ±0.04	71.50 ±0.15	5.51 ±0.01	19.88 ±0.04	1.00 ±0.01	3.61 ±0.04	1.39 ±0.02	5.01 ±0.07	134.71 ±1.20	485.97 ±4.33
	10%	72.32 ±0.07	19.38 ±0.04	70.00 ±0.16	5.32 ±0.02	19.22 ±0.07	1.00 ±0.01	3.61 ±0.04	1.98 ±0.02	7.15 ±0.07	133.72 ±0.78	483.09 ±2.82
	15%	72.14 ±0.11	18.94 ±0.05	67.98 ±0.18	5.18 ±0.01	18.59 ±0.04	1.02 ±0.01	3.66 ±0.04	2.76 ±0.03	9.91 ±0.11	133.97 ±0.91	480.87 ±3.28
	20%	72.40 ±0.08	18.66 ±0.05	67.61 ±0.18	4.92 ±0.02	17.83 ±0.07	1.06 ±0.01	3.84 ±0.04	2.96 ±0.09	10.72 ±0.33	131.35 ±1.19	475.90 ±4.30
	25%	72.44 ±0.07	18.16 ±0.05	65.89 ±0.18	4.68 ±0.01	16.98 ±0.04	1.08 ±0.01	3.92 ±0.04	3.64 ±0.10	13.21 ±0.36	130.05 ±0.98	471.88 ±3.57
Local minced meat	A	63.96 ±0.11	19.82 ±0.07	54.99 ±0.19	14.06 ±0.03	39.01 ±0.08	1.15 ±0.01	3.19 ±0.04	1.01 ±0.02	2.80 ±0.06	210.06 ±1.24	588.85 ±3.44
	B	64.83 ±0.09	20.45 ±0.08	58.15 ±0.23	12.36 ±0.03	35.14 ±0.09	1.22 ±0.01	3.47 ±0.04	1.14 ±0.03	3.24 ±0.09	197.83 ±1.20	562.50 ±3.42

S.D.: Standard division. W.W.: Wet weight basis. D.W.: Dry weight basis

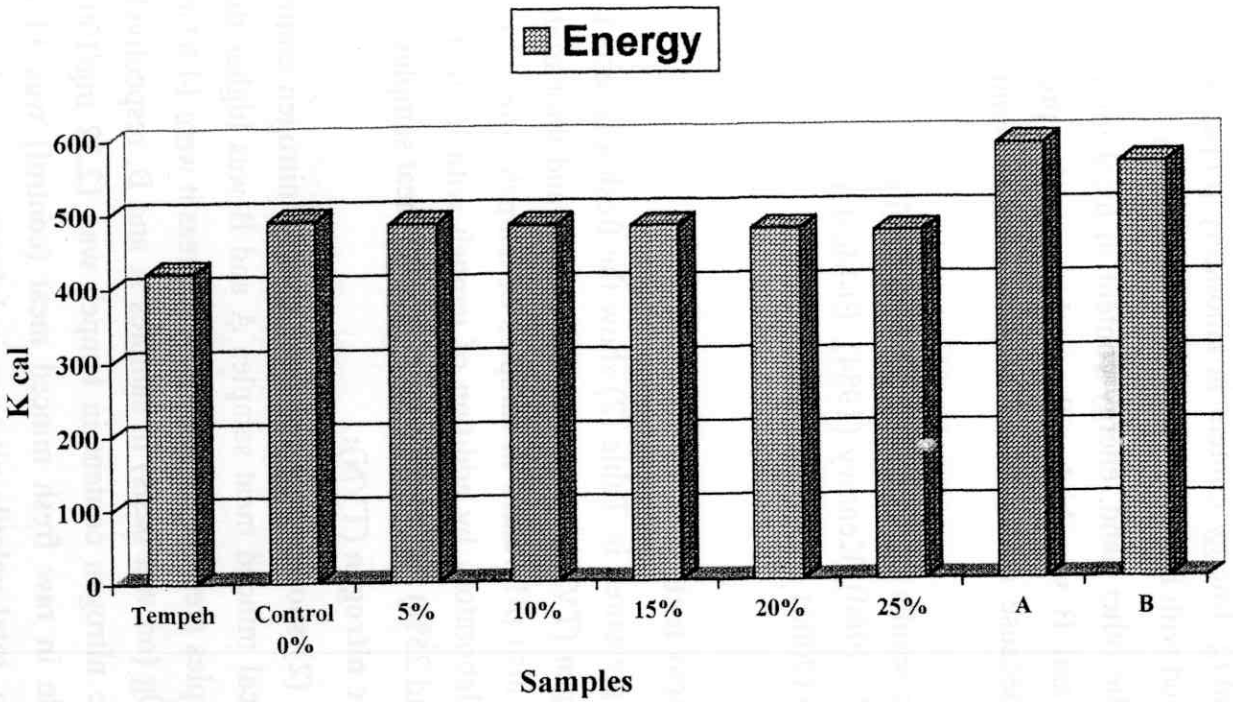


Fig. (2): Total energy K cal./g in tempeh, minced meat samples prepared in laboratory mixed with tempeh by (0, 5, 10, 15, 20 & 25%) and local minced meat samples (A & B) (on dry weight basis).

While, energy content in fresh raw minced meat (control) was 489.76 K cal./g. Energy content in laboratory prepared samples was decreased with increasing tempeh level addition.

On the other hand, energy content in local minced meat samples A and B was higher than other samples prepared in laboratory because ether extract content in local samples was high.

These results are in agreement with Lotfi *et al.* (1978), El-Aswad *et al.* (1980), Kenawy (1984), El-Moshtohry (1997) and Abd El-Aziz (2000)

1.2. Freshness tests:

Data presented in Table (2) show the freshness tests total volatile nitrogen (TVN), trimethylamine (TMA) and thiobarbituric acid (TBA), also pH values in samples of tempeh, minced meat prepared in laboratory by addition of tempeh with levels (0, 5, 10, 15, 20 and 25%) and the two local minced meat samples.

Total volatile nitrogen (TVN):

Table (2) showed that the total volatile nitrogen content (TVN) in local minced meat samples A and B was higher than other all samples prepared in laboratory, whereas it were 14.67 and 15.44 mg/100g (on wet basis) in samples A and B, respectively. Total volatile nitrogen content in tempeh was 12.32 mg/100 g sample, while in raw fresh minced meat (control) was 11.76 mg/100 g. So, total volatile nitrogen in laboratory samples was increased with increasing tempeh levels addition from 5 to 25%, it reached to 11.90 mg/100 g on wet basis.

Table (2): Freshness test of tempeh, minced meat prepared in laboratory mixed with tempeh and local minced meat samples (mean ± S.D.).

Component	Tempeh	Minced meat prepared in laboratory mixed with tempeh by						Local minced meat	
		0% (control)	5%	10%	15%	20%	25%	A	B
T.V.N. mg/100 g	12.32 ±0.03	11.76 ±0.04	11.80 ±0.03	11.82 ±0.03	11.85 ±0.02	11.88 ±0.03	11.90 ±0.02	14.67 ±0.04	15.44 ±0.03
T.M.A. mg/100 g	1.17 ±0.02	0.82 ±0.01	0.84 ±0.03	0.86 ±0.01	0.88 ±0.02	0.90 ±0.01	0.92 ±0.01	2.40 ±0.02	2.88 ±0.03
T.B.A. mg/kg*	0.43 ±0.03	0.23 ±0.01	0.24 ±0.02	0.25 ±0.01	0.26 ±0.01	0.27 ±0.01	0.28 ±0.01	0.85 ±0.01	0.66 ±0.01
pH	6.25 ±0.04	5.90 ±0.02	5.92 ±0.03	5.94 ±0.01	5.96 ±0.02	5.98 ±0.02	6.00 ±0.02	5.95 ±0.02	5.88 ±0.02

T.V.N. : Total volatile nitrogen
T.M.A. : Trimethylamine
T.B.A. : Thiobarbituric acid.
* mg malonaldhyde/kg

These results are in agreement with Fouda (1986) who found TVN in minced meat in zero time was 9.24 mg/100 g and reached to 20.55 mg/100 g after 5 months of frozen storage at –10°C.

Trimethylamine (TMA):

Also, Table (2) indicated that trimethylamine (TMA) content in local minced samples A and B was high compared to laboratory prepared samples, they were 2.40 and 2.88 mg/100 g in local samples A and B, respectively. Trimethylamine in tempeh was 1.17 mg/100 g, while in raw fresh minced meat (control) was 0.82 mg/100 g. So, trimethylamine content in laboratory samples was increased with increasing tempeh level addition from 5 to 25%, it reached to 0.92 mg/ 100 g.

Thiobarbituric acid (TBA):

Thiobarbituric acid content (TBA) in local minced samples A, B was higher than all laboratory prepared samples, whereas it were 0.85 and 0.66 mg malonaldhyde/kg sample in local samples A and B, respectively. Thibarbituric acid content in tempeh was 0.43 mg/kg, while in raw fresh minced meat (control) was 0.23 mg/kg. So, thiobarbituric acid content in all laboratory prepared samples was increased with increasing tempeh levels addition from 5 to 25%, it reached to 0.28 mg/kg. These results are in agreement with those obtained by Fouda (1986) who found at zero time was 0.26 mg/kg samples and reached to 6.70 at the end of frozen storage period (6 months).

pH values:

The same Table showed that pH values in tempeh was 6.25, while in raw fresh minced meat was 5.90. So, pH values in all laboratory prepared samples were increased with increasing tempeh level addition from 5 to 25%. pH values in local minced samples A and B were 5.95 and 5.88, respectively. The results are in agreement with Abd El-Salam (1978), Thomposn *et al.* (1978), Mahmoud (1987), El-Moshtohry (1997), Wang *et al.* (1997) and Abd El-Aziz (2000).

1.3. Microbiological examinations:

Table (3) showed the total bacterial count, moulds and yeasts in tempeh, minced meat prepared in laboratory mixed with tempeh and local minced meat A and B samples. Tempeh had low total bacterial count $2.4x10^2$ cfu/g, while in raw fresh minced meat (control) was $1.4x10^5$ cfu/g. The total bacterial count for minced meat prepared in laboratory with addition of temepeh levels ranged from $2.8x10^6$ to $5.7x10^6$ cfu/g, but in local minced meat samples A and B were $2.5x10^6$ and $3.6x10^6$ cfu/g, respectively. Moulds and yeasts were nil in all samples.

These results are in agreement with Pearson (1968), Roushdy (1971), Saied *et al.* (1974), El-Mswiler *et al.* (1976), Sumner *et al.* (1979), Darwish *et al.* (1986) Mousa *et al.* (1993), and El-Moshtohry (1997).

Table (3): Total bacterial count, moulds and yeasts of tempeh, minced meat prepared in laboratory mixed with tempeh and local minced meat samples.

Samples		Total bacterial count		Moulds & yeasts	
		Number c.f.u./g	Log number	Number c.f.u./g	Log number
Tempeh		$2.4x10^2$	2.38	Nil	-
Minced meat prepared in laboratory mixed with tempeh by	0% (control)	$1.4x10^5$	5.15	Nil	-
	5%	$4.3x10^6$	6.63	Nil	-
	10%	$2.8x10^6$	6.45	Nil	-
	15%	$5.2x10^6$	6.72	Nil	-
	20%	$5.0x10^6$	6.70	Nil	-
	25%	$5.7x10^6$	6.76	Nil	-
Local minced meat	A	$2.5x10^6$	6.40	Nil	-
	B	$3.6x10^6$	6.56	Nil	-

1.4. Sensory evaluation:

Data in Table (4) and illustrated Fig. (3) indicated that there are significant differences ($P < 0.05$) between minced low fat meat samples prepared in laboratory by addition tempeh levels (0-25%) for taste, texture, odour, cutting and overall acceptability. There was no significant difference ($P > 0.05$) in colour of the different low fat minced meat samples mixed with tempeh from 0 to 25%. Anyhow, the minced meat samples could be separated into two groups hence there are not significant difference ($P > 0.05$) between any two samples within the same group. The first group includes minced meat samples mixed with 0, 5, 10 and 15% tempeh. The second group includes minced meat samples mixed with 20 and 25% tempeh. In the same time there is significant difference ($P < 0.05$) between the two groups. The second group obtained the high scores (82.8, 83.4). These data indicated that mixing low fat minced meat with 20 and 25% tempeh led to significant increase ($P < 0.05$) in the overall acceptability of the obtained mixture. So, it could be recommended to apply mixing tempeh to improve the acceptability of the minced low fat meat.

These results are in agreement with Egbert *et al.*, (1991) and Berry (1993).

Table (4): Sensory evaluation of minced meat samples prepared in laboratory mixed with tempeh levels (0-25%).

Minced meat prepared in laboratory mixed with tempeh	Taste (30)	Colour (20)	Texture (20)	Odour (15)	Cutting (15)	Overall Acceptability (100)
0% control	21.6^{b}	16.9^{a}	15.4^{a}	11.3^{ab}	11.8^{b}	77.0^{b}
5%	21.9^{b}	16.6^{a}	16.3^{a}	11.2^{b}	12.3^{ab}	77.4^{b}
10%	21.2^{b}	16.2^{a}	16.4^{a}	11.7^{ab}	12.5^{ab}	78.0^{b}
15%	23.4^{ab}	16.3^{a}	16.4^{a}	12.4^{ab}	12.3^{ab}	80.8^{ab}
20%	24.4^{a}	16.1^{a}	16.7^{a}	12.7^{a}	12.9^{a}	82.8^{a}
25%	24.8^{a}	16.4^{a}	16.7^{a}	12.7^{a}	12.8^{a}	83.4^{a}
L.S.D. at 0.05	2.45	1.19	1.43	1.47	0.98	5.25

a and b: There is no significant difference between any two means, within the same column.

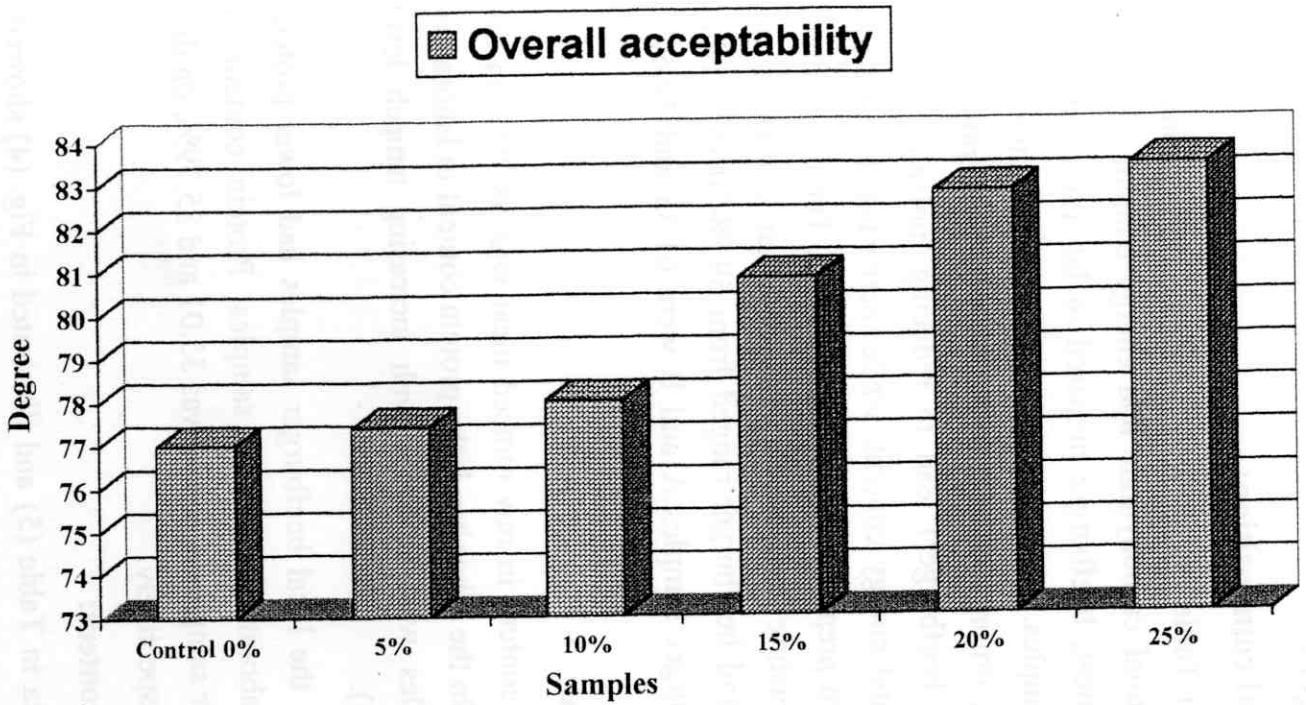


Fig. (3): Overall acceptability in minced meat samples prepared in laboratory mixed with tempeh by (0, 5, 10, 15, 20 & 25%).

2. Beefburger:

2.1. Chemical composition:

Data in Table (5) showed moisture, curde protein, ether extract, ash, total carbohydrate and energy content in tempeh, raw minced meat, beefburger prepared in laboratory and local beefburger samples. It is indicated that the addition of spices blends, garlic, onion and sodium chloride to fresh raw minced meat (control beefburger) lead to reducing moisture, protein, ether extract and energy content, while increasing ash and total carbohydrate in prepared beefburger (control). Tempeh contains the highest moisture content (72.68%). Moisture content in raw minced meat and beefburger ranged from 69.98-70.75%, while in local beefburger samples A and B were 61.33 and 59.62%, respectively.

Protein content:

Protein content in raw minced meat was 68.75% on dry weight basis. On the other hand, the protein content in laboratory prepared samples was decreased with increasing tempeh level addition (Fig., 4).

Besides, the local beefburger samples had lower protein content than laboratory prepared samples. Protein content in local beefburger samples A and B was 35.01 and 35.79%, on dry weight basis, respectively.

Ether extract content:

Also, data in Table (5) and illustrated in Fig. (4) showed that the ether extract content in laboratory prepared low fat beefburger samples was lower than control. But local beefburger

Table (5): Chemical composition of tempeh, raw minced meat, beefburger prepared in laboratory mixed with tempeh and local beefburger samples (mean ± S.D.).

Sample		Moisture %	Crude protein %		Ether extract %		Ash %		Total carbohydrate %		Energy K cal/g	
			W.W.	D.W.	W.W.	D.W.	W.W.	D.W.	W.W.	D.W.	W.W.	D.W.
Tempeh		72.68 ±0.08	14.24 ±0.07	52.12 ±0.27	1.66 ±0.01	6.08 ±0.04	1.16 ±0.02	4.25 ±0.07	10.26 ±0.03	37.55 ±0.11	114.99 ±0.88	420.90 ±3.22
Raw minced meat		70.75 ±0.08	20.11 ±0.08	68.75 ±0.26	7.17 ±0.02	24.51 ±0.07	1.08 ±0.01	3.69 ±0.03	0.89 ±0.01	3.04 ±0.03	148.71 ±1.01	508.41 ±3.45
Beafburger prepared in laboratory mixed with tempeh by	0% control	70.14 0.08	19.90 ±0.04	66.64 ±0.14	7.10 ±0.02	23.78 ±0.07	1.56 ±0.01	5.22 ±0.03	1.30 ±0.01	4.35 ±0.03	148.96 ±0.78	498.86 ±2.62
	5%	69.98 ±0.07	19.62 ±0.04	65.36 ±0.13	6.82 ±0.02	22.72 ±0.06	1.62 ±0.01	5.40 ±0.03	1.96 ±0.01	6.53 ±0.03	148.09 ±0.96	493.30 ±3.20
	10%	70.16 ±0.10	19.34 ±0.05	64.81 ±0.17	6.56 ±0.01	21.98 ±0.03	1.64 ±0.01	5.50 ±0.03	2.30 ±0.02	7.71 ±0.07	146.06 ±0.84	489.48 ±2.82
	15%	70.34 ±0.08	19.25 ±0.05	64.90 ±0.18	6.30 ±0.01	21.24 ±0.04	1.56 ±0.01	5.26 ±0.03	2.55 ±0.02	8.60 ±0.07	144.41 ±1.20	486.88 ±4.05
	20%	70.51 ±0.06	18.80 ±0.08	63.75 ±0.26	6.02 ±0.02	20.41 ±0.07	1.58 ±0.01	5.36 ±0.03	3.09 ±0.02	10.48 ±0.06	142.36 ±0.88	482.74 ±2.98
	25%	70.55 ±0.09	18.54 ±0.06	62.95 ±0.21	5.81 ±0.02	19.72 ±0.07	1.58 ±0.01	5.37 ±0.03	3.52 ±0.01	11.95 ±0.03	135.56 ±0.80	460.31 ±2.72
Local beef-burger	A	61.33 ±0.11	13.54 ±0.09	35.01 ±0.24	17.40 ±0.04	45.00 ±0.10	2.68 ±0.02	6.93 ±0.06	5.05 ±0.03	13.06 ±0.08	231.97 ±1.60	599.87 ±4.10
	B	59.62 ±0.06	14.45 ±0.08	35.79 ±0.22	16.64 ±0.03	41.21 ±0.07	2.48 ±0.03	6.14 ±0.07	6.81 ±0.03	16.85 ±0.09	236.19 ±1.44	584.91 ±3.57

S.D.: Standard division. W.W.: Wet weight basis. D.W.: Dry weight basis

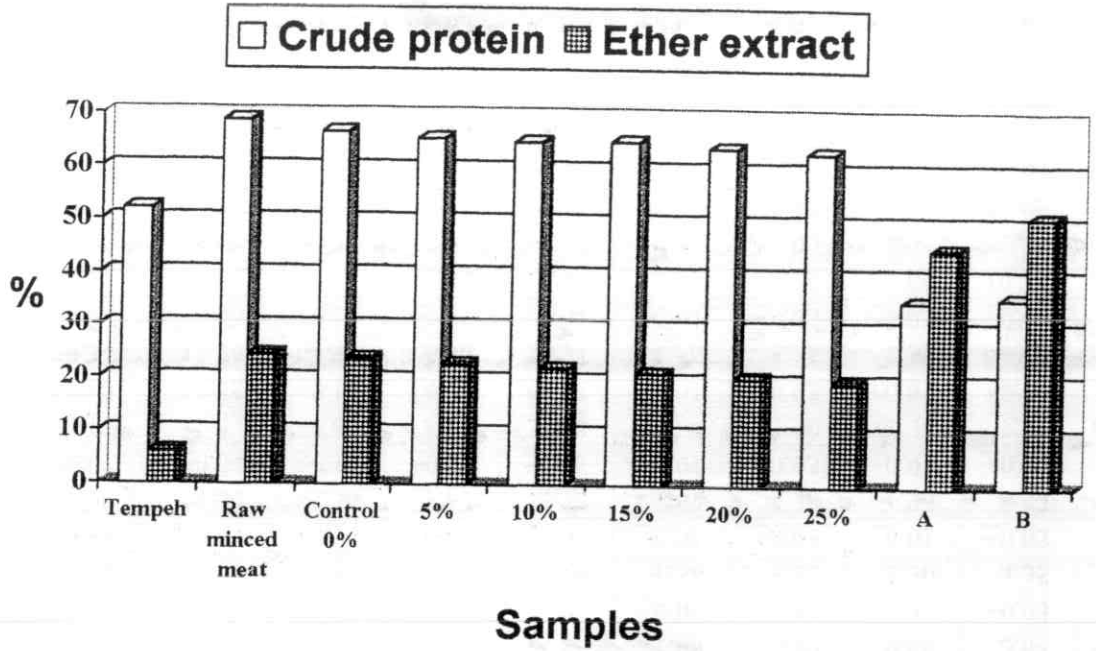


Fig. (4): Crude protein and ether extract in tempeh, raw minced meat beefburger samples prepared in laboratory mixed with tempeh by (0, 5, 10, 15, 20 & 25%) and local beefburger samples (A & B) (on dry weight basis).

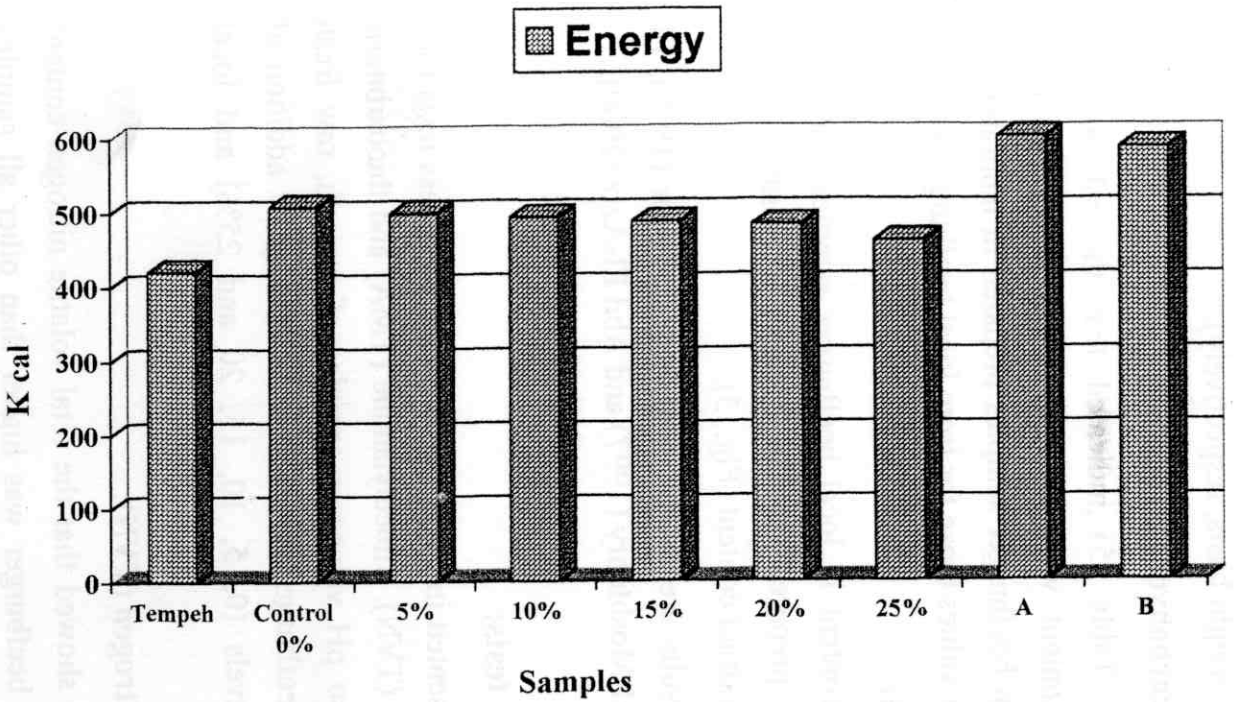


Fig. (5): Total energy K cal./g in tempeh, beefburger samples prepared in laboratory mixed with tempeh by (0, 5, 10, 15, 20 & 25%) and local beefburger samples (A & B) (on dry weight basis).

samples A and B had higher content of ether extract (45.00 and 41.21%, on dry weight basis, respectively).

Ash and total carbohydrates content:

Data in Table (5) indicated that the ash and total carbohydrate content were increased with increasing tempeh level addition in beefburger samples prepared in laboratory, but they were lower values those for from local beefburger samples.

Energy content:

Energy content in local beefburger samples was higher than laboratory prepared samples because local samples were higher in ether extract content (Fig., 5).

These results are inagreement with El-Nemr (1979), El-Akary (1986), El-Moshtohry (1997) and Abd El-Aziz (2000).

2.2. Freshness tests:

Data presented in Table (6) show the freshness tests total volatile nitrogen (TVN), trimethylamine (TMA) and thiobarbituric acid (TBA), also pH values in samples of tempeh, raw fresh minced meat, beefburger prepared in laboratory by addition of tempeh with levels (0, 5, 10, 15, 20 and 25%) and local beefburger.

Total volatile nitrogen (TVN):

Table (6) showed that the total volatile nitrogen content (TVN) in local beefburger was higher than other all samples prepared in laboratory, whereas it was 14.67 and 14.22 mg/100g (on wet basis) in samples A and B, respectively. Total volatile

Table (6): Freshness test of tempeh, raw minced meat, beefburger prepared in laboratory mixed with tempeh and local beefburger samples (mean ± S.D.).

Component	Tempeh	Raw minced meat	Beefburger prepared in laboratory mixed with tempeh by						Local beefburger	
			0% (control)	5%	10%	15%	20%	25%	A	B
T.V.N. mg/100 g	12.32 ±0.03	12.12 ±0.02	12.38 ±0.03	12.38 ±0.02	12.37 ±0.02	12.36 0.02	12.34 ±0.01	12.34 ±0.01	14.67 ±0.03	14.22 ±0.02
T.M.A. mg/100 g	1.17 ±0.02	0.96 ±0.01	0.98 ±0.01	0.99 ±0.01	1.00 ±0.01	1.02 ±0.01	1.03 ±0.01	1.04 ±0.01	2.95 ±0.02	3.25 ±0.01
T.B.A. mg/kg*	0.43 ±0.03	0.26 ±0.01	0.30 ±0.01	0.31 ±0.01	0.32 ±0.01	0.34 ±0.01	0.35 ±0.01	0.36 ±0.01	0.98 ±0.01	0.96 ±0.01
pH	6.25 ±0.04	5.92 ±0.02	6.28 ±0.02	6.28 ±0.02	6.28 ±0.02	6.26 ±0.01	6.26 ±0.01	6.26 ±0.01	6.00 ±0.02	6.20 ±0.01

T.V.N. : Total volatile nitrogen
T.M.A. : Trimethylamine
T.B.A. : Thiobarbituric acid.
* mg malonaldhyde/kg

nitrogen content in tempeh was 12.32 mg/100 g sample, while in raw fresh minced meat was 12.12 mg/100 g, but in control beefburger (0%) was 12.38 mg/100 g. Total volatile nitrogen in laboratory samples was increased with increasing tempeh levels addition from 5 to 25%. These results are agreed with data reported by Fouda (1986), who mentioned that TVN in beefburger at zero time 8.89 mg/100 g and reached to 19.65 mg/100 g after 5 month of frozen storage at –10°C.

Trimethylamine (TMA):

Also, Table (6) indicated that trimethylamine (TMA) content in local beefburger samples A and B was high comparing to laboratory prepared samples, it was 2.95 and 3.25 mg/100 g in local samples A and B, respectively. Trimethylamine content in tempeh was 1.17 mg/100 g, while in raw fresh minced meat it was 0.96 mg/100 g, but in control beefburger it was 0.98 mg/100 g. Trimethylamine content in laboratory samples was increased with increasing tempeh level addition from 5 to 25%.

Thiobarbituric acid (TBA):

Thiobarbituric acid content (TBA) in local beefburger samples was higher than all laboratory prepared samples, whereas it was 0.98 and 0.96 mg malonaldhyde/kg sample in local samples A and B, respectively. Thiobarbituric acid content in tempeh was 0.43 mg/kg, while in raw fresh minced meat it was 0.26 mg/kg, but in control beefburger was 0.30. Thiobarbituric acid content in all laboratory prepared samples was increased with increasing tempeh levels addition from 5 to 25%.

pH values:

The same Table showed that pH value in tempeh was 6.25, while in raw fresh minced meat was 5.92, but in control beefburger was 6.28. Also, pH values in all laboratory prepared samples were increased with increasing tempeh level addition from 5 to 25%. pH values in local beefburger samples A and B were 6.00 and 6.20, respectively.

The results are in agreement with Freeman *et al.* (1982), El-Moshtohry (1997) and Abd El-Aziz (2000).

1.3. Microbiological examination:

Results of total bacterial count, moulds and yeasts in tempeh, raw fresh minced meat, beefburger prepared in laboratory and local beefburger A and B samples are shown in Table (7). Tempeh had low total bacterial count $2.4x10^2$ cfu/g, while in raw fresh minced meat and control beefburger (0%) were $1.8x10^5$ and $2.6x10^5$ cfu/g, respectively. The total bacterial count of beefburger prepared in laboratory with addition of tempeh levels ranged from $3.2x10^6$ to $5.5x10^6$ cfu/g, but in local beefburger samples A and B were $4.0x10^6$ and $3.2x10^6$ cfu/g, respectively. Moulds and yeasts were nil in all samples.

These results are in agreement with Lin *et al.* (1977), Tamminga *et al.* (1982), Darwish *et al.* (1986), Abd El-Aziz (2000) and Habbal (2000).

Table (7): Total bacterial count moulds and yeasts of tempeh, raw minced meat, beefburger prepared in laboratory mixed with tempeh and local beefburger samples.

Samples		Total bacterial count		Moulds & yeasts	
		c.f.u./g	Log number	Number c.f.u./g	Log number
Tempeh		$2.4x10^2$	2.38	Nil	-
Raw minced meat		$1.8x10^5$	5.26	Nil	-
Beefburger prepared in laboratory mixed with tempeh by	0% (control)	$2.6x10^5$	5.41	Nil	-
	5%	$3.2x10^6$	6.51	Nil	-
	10%	$3.8x10^6$	6.58	Nil	-
	15%	$4.6x10^6$	6.66	Nil	-
	20%	$5.5x10^6$	6.74	Nil	-
	25%	$3.5x10^6$	6.54	Nil	-
Local beef-burger	A	$4.0x10^6$	6.60	Nil	-
	B	$3.2x10^6$	6.51	Nil	-

1.4. Sensory evaluation:

Data in Table (8) and illustrated in Fig. (6) indicated the significant difference ($P < 0.05$) between beefburger samples prepared in laboratory mixed with tempeh levels (0-25%) for taste, colour, texture, odour, cutting and overall acceptability. Sample prepared by addition 25% tempeh was the best from all samples. It was obtained the highest degree from panelists for taste, colour, texture, odour, cutting and overall acceptability.

Statistical analysis indicated that there is no significant difference (for overall acceptability) between beefburger samples prepared with addition of 0% to 20% tempeh ($P > 0.05$). On the other hand beef burger containing 25% tempeh obtained the highest scores of overall acceptability (86.9). So, it could be recommended to apply mixing with 25% tempeh to improve overall acceptability of low fat meat beefburger.

Results are in agreement with El-Aswad *et al.* (1980), El-Sanafiry (1983) and Dreeling *et al.* (2000).

Table (8): Sensory evaluation of beefburger samples prepared in laboratory mixed with tempeh levels (0-25%).

Beefburger prepared in laboratory mixed with tempeh	Taste (30)	Colour (20)	Texture (20)	Odour (15)	Cutting (15)	Overall Acceptability (100)
0% control	23.6^{a}	16.7^{bc}	15.9^{b}	12.4^{ab}	12.4^{c}	81.0^{b}
5%	22.8^{a}	16.5^{bc}	16.3^{ab}	12.0^{b}	12.8^{bc}	80.4^{b}
10%	22.8^{a}	17.3^{abc}	16.1^{bb}	12.3^{ab}	13.0^{abc}	81.5^{b}
15%	23.0^{a}	16.2^{c}	16.5^{ab}	12.5^{ab}	13.0^{abc}	81.2^{b}
20%	23.8^{a}	17.4^{ab}	16.9^{ab}	12.9^{ab}	13.4^{ab}	84.4^{ab}
25%	24.3^{a}	18.0^{a}	17.6^{a}	13.4^{a}	13.6^{a}	86.9^{a}
L.S.D. at 0.05	1.71	1.12	1.32	1.10	0.64	3.80

a and b: There is no significant difference between any two means, within the same column.

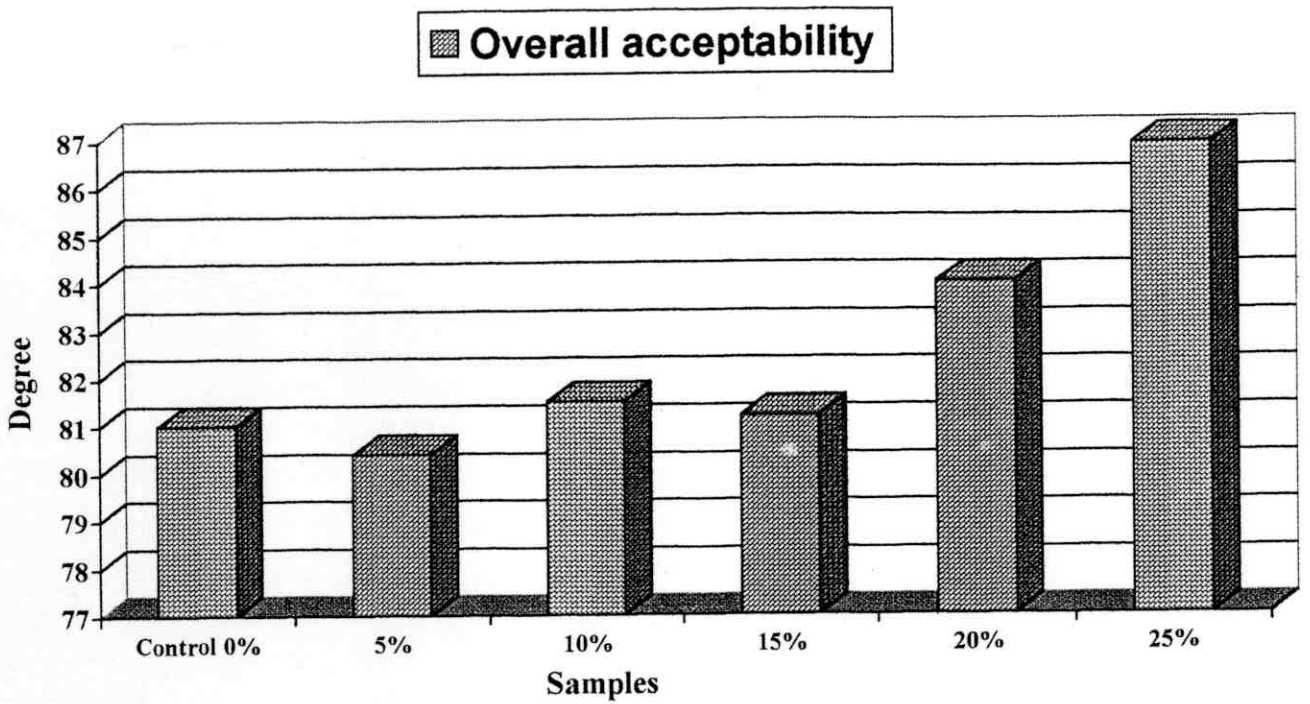
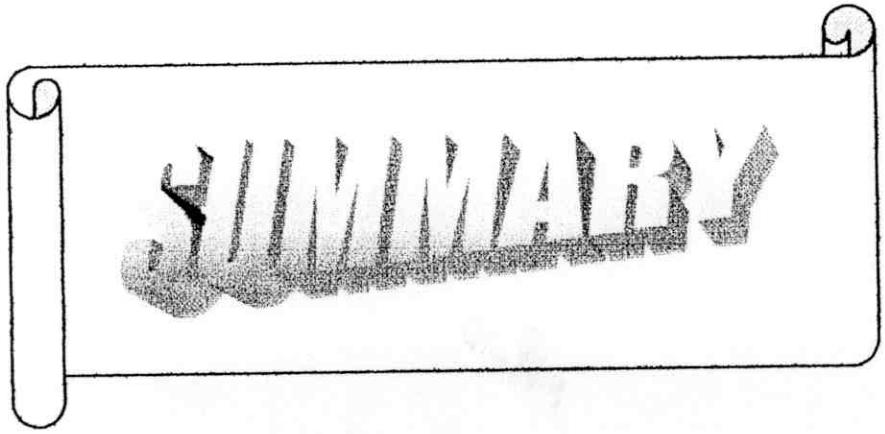


Fig. (6): Overall acceptability in beefburger samples prepared in laboratory mixed with tempeh by (0, 5, 10, 15, 20 & 25%).


SUMMARY