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FUNCTIONAL PROPERTIES OF LUPINE AND CHICKPEA FLOURS AND ITS APPLICATION IN BEEF PATTIES

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ABSTRACT

Defatted lupine and chickpea flours were prepared; the effect of different pH values and heat treatments on their functional properties was studied. Functional properties were measured at pH values ranged between 2 to 10 in order to evaluate the potential use of this promising protein sources in different food systems. The effect of addition (10, 15, 20, 25, 30 and 35% levels) of defatted lupine and chickpea flours to the formulation of cooked beef patties was investigated. The obtained data indicated that water absorption of defatted lupine flour was higher than that of defatted chickpea flour. Water absorption was affected by different pH values and temperatures. Chickpea flour gave a higher foam capacity than lupine flour. Chickpea flour exhibited less foam stability than lupine flour at all pH values.

Lupine flour gave considerably higher nitrogen solubility index at all pH values than chickpea flour. Heat treatment at 70°C for 20min. improved the solubility of defatted flours. The defatted lupine and chickpea flour registered the highest emulsion stability at both acidic and alkaline pH values after standing 60 min. at room temperature.

Gradual increase in cooking yield of beef patties by increasing the percentage of substitution by hydrated lupine or chickpea flour was observed. There is an inverse relationship between both of the shrinkage and cooking loss with levels of substitution. Patties containing hydrated flours gave high juiciness scores after cooking by broiling or microwave treatments. No significant differences in flavor characteristic could be observed for the patty tested samples except for those substituted with 35% of lupine or chickpea flour which gave the lowest flavor ratings than the other samples. Finally, this study showed a possibility of using hydrated flours (till 30%) as one of the main ingredients in such functional blends that might be useful in producing substituted meat patties.

Keywords: lupine, chickpea, Flour, Functional properties, Beef patties.

INTRODUCTION

Chemical composition of lupine was studied by Petterson and Crosbie (1990); Mohamed and Rayas-Duarte (1995). The nutritional quality was evaluated by Camacho *et al.,* (1989); Yen *et al.,* (1990) and functional properties were investigated according to Aguilera (1989). Also, the potential for using lupine as food for humans (lupine milk, snack foods, fermented foods, dietary fiber) is discussed by Petterson and Crosbie (1990). Lupine protein isolate from seeds was used as powder ingredient for manufacture of frankfurters (Alamanou *et al.,* 1996) and used in chopped meat (Zagibalov *et al.,* 1989)

Lupine offers several potential advantages over soybeans. In particular, the digestibility of lupine protein and oil is superior to that of soybean. Lupine has a lower content of trypsin inhibitors, which can interfere with digestive processes, and less phytic acid, which binds minerals such as calcium and zinc to reduce their bioavailability. Lupines have lower levels of saponins and lectins, which can act as gastric irritants (Pollard *et al.*, 2002). However, the utilization of lupines has been limited by the presence of toxic alkaloids and other antinutritional factors, (Muzquiz *et al.*, 1999), these compounds can, however, be eliminated through different technological treatments (Mohamed *et al.,* 1987; Santana *et al,* 1990; Jimenez-Martinez *et al.,* 2003). Lupine seeds represent an important source of protein for animal and human consumption (30-40 %protein content), (Imane and Al- Faiz, 1999).

Chickpea (*Cicer arietinum L.*) is the most important grain legume in the world on the basis of total grain production (FAO, 1993). Chickpea is an economical source of protein, calories, vitamins and minerals for millions of people around the world (Singh and Seetha, 1993). Among legume seeds, chickpea has the best protein quality and exhibit higher net protein utilization than soybeans, beans and lentils.(Chavan *et al.*, 1986).

Chickpea flour is nutritionally adequate and may be considered as an ingredient for substitution of some foods products. Chemical composition of chickpea was discussed by Attia *et al.*, (1994); Gaborcik (1995); Jood *et.al.*, (1998) and the nutritional quality was evaluated by Barron *et al.*, (1992). Functional properties and utilization of chickpea flours were studied by Hung *et al.*, (1993); Dodok *et al.,* (1993); Savita *et al.*, (1995); Valim and Batistuti (1998).

In spite of, lupine and chickpea have the best protein quality, the studies on their utilization of lupines and chickpea for incorporating in meat products is limited. Therefore, the specific objectives of this research were to prepare defatted lupine and chickpea flours and to study their functional properties at different pH values (2, 4, 6, 8, 10 and at original pH) and different temperatures (4°C, 25°C and 70°C). Results on functional properties of defatted lupine and chickpea flours would be useful for predicting food applications. The effect replacements of defatted lupine and chickpea flours to the formulation of beef patties at 10, 15, 20, 25, 30 and 35% levels on cooking quality characteristics of the prepared beef patties by different cooking methods were investigated.

MATERIALS AND METHODS

Materials:

Lupine (*Lupinus termis*) and chickpea (*Cicer arietinum, L.*) seeds , meat from round cuts and spices were obtained from local market.

Methods:

Preparation of Full-Fat and Defatted Lupine and Chickpea Flours:

Lupine and chickpea seeds were cleaned from broken seeds, dust and other foreign materials. The seeds were soaked in tap water (1:5 w/v) overnight at room temperature (25 °C±2). The soaked lupine seeds were boiled for one hour to destroy the seed's terminative capacity, inhibit the enzymes and to reduce the loss of protein through their coagulation and to facilitate the physical removal of alkaloids by washing. Then, the seeds were washed with running tap water for 4 days, to remove bitter materials (alkaloids) as recommended by Santana *et al.*, (1990); Tsaliki *et al.*, (1999).

Chickpea seeds were blanched immediately for 30 min. then drained and washed with running tap water. Seeds of lupine or chickpea were mashed in a blender and then dried overnight at 60°C. The dried samples were ground to pass through a 60-mesh sieve, then reground and resieved. The resultant fine flour termed as (full-fat chickpea and lupine flour). Flour samples were defatted at room temperature, by soaking in hexane for six times (each one, 12 hr.). The resultant defatted samples were dried for 72 hr. at room temperature, and reground, then passed through 60-mesh sieve to obtain defatted lupine and chickpea fine flours.

Chemical Analysis:

Moisture, fat, ash and total protein (N×6.25) were assayed according to AOAC (1990).

Functional properties:

Water absorption:

Water absorption of defatted lupine and chickpea flours was assayed, based on the method of Liu and Hung (1998). Add 2.5 g flour to distilled water (47.5ml) after adjusting the pH ranging from 2 to 10, followed by stirring the samples for 5 min. The mixtures were allowed to stand for 30min. at different temperatures (4, 25 and 70°C). The slurries were centrifuged at 2000 xg. The amount of residual water was carefully removed by decantation. Water absorption was calculated by weight difference.

Foaming Capacity and Stability:

Foam capacity and stability of defatted lupine and chickpea flours were measured at different pH values according to Wilde and Clark, (1996). Sample dispersions of 2% (w/v) in distilled water were adjusted to the pH as mentioned above. The dispersions were whipped for one min. with the mixer at the high speed. Foam expansion was measured immediately within 30 sec. and expressed as a foam capacity. The volume of foam remaining after standing for 20, 40 and 60 min. was recorded as foam stability. Volume increase (%) was calculated according to the following equation.

Volume increase (%) = Volume after whipping (ml) -Volume before whipping (ml) x100 / Volume before whipping (ml)

Nitrogen Solubility:

Nitrogen solubility index (%) was determined by the method of Bera and Murkherjee, (1989). Aqueous suspensions of defatted lupine and chickpea flours were prepared at the pH ranging between (2 to 10) followed by stirring the samples for 30 min. at room temperature (25 °C) and 70 °C. The slurries were centrifuged at 2000 xg. The nitrogen content of supernatants was determined by the kjeldahl method (AOAC, 1990). Nitrogen solubility index being expressed as percent nitrogen extracted from the original sample.

Emulsion Activity and Stability:

The method of Pearce and Kinsella, (1978) was employed to determine of emulsion activity and stability of defatted lupine and chickpea flours at different pH values as mentioned above. Corn oil and sample suspensions, (10 and 30 ml, respectively) was homogenized using warring blendor for one minute, 0.1 ml of the prepared emulsion were immediately taken from the bottom of the vessel and diluted to 50 ml with 0.1% sodium dodecyl sulfate (SDS). Absorbency of the resulting dispersion was measured at 500 nm using a Jenway, 6105 uv/vis spectrophotometer aganist 0.1% SDS solution as blank. Emulsion activity and emulsion stability indices (EAI and ESI, respectively) were measured using the following equation. (m^2/g protein) after 20, 40 and 60 min.

EAI or ESI = 2x2.303xA_{500nm} / 25xlength of cuvette x protein concentrations

Preparation of Beef Patties:

Lupine or chickpea flours were hydrated with tap water (1:1.5, 1:1.2 w/v), respectively were replaced by 10, 15, 20, 25, 30 and 35% of the ground beef meat (protein 21.52%, fat 4.63% and moisture 72.33%) in patties mixtures. Salt 2%, spices mixture 3%, minced garlic 2.5% and onion 6% were added to substituted patties mixture and reground. Control sample (full beef patty) was prepared without addition of defatted flours. All patties were formed by a patty maker (80g mold) 0.9 cm. thickness and 9.5 cm. diameter. Formed patties were placed between squares of polyethylene, layered on plates and packaged in polyethylene in groups then frozen and stored at -18°C till further analyses (Kamnau *et al.*, 1997).

Cooking of Beef Patties:

Frozen beef patties with or without defatted lupine or chickpea flour were cooked by different methods. Broiling cooking was carried out in hot-air oven (Koncar type EBE-30) at 180°C±5°C for 20 minutes (13 min. in first side and 7 min. on the second side) of patty. Microwave cooking was conducted by microwave oven ((Moulinex, 200 W. 2450 MHZ) for 10 min. (Nath *et al.*, 1996).

Cooking Quality Measurements:

Cooking yield and cooking loss of patties were calculated by difference of the weight before and after cooking. Shrinkage was measured according the difference of diameter. Cooking yield, cooking loss and shrinkage were determined as described by Gharimi *et al.*, (1987) and Berry *et al.*, (1985).

Sensory Evaluation of Beef Patties:

Samples of cooked beef patty were evaluated by eight experienced panelists, from the staff of the Department of Food Science, Faculty of Agriculture, Ain Shams University. The panelists evaluated the sensory quality of patty samples (color, texture, flavor, juiciness and overall acceptability). The samples were presented to panelists randomly. Each panelist was given one beef patty (control sample) as a reference sample labeled "R". The beef patties were evaluated according to Larmond, (1970) as follows: No difference from (R) = 5, (extreme desirable than (R) = 9, extreme inferior than (R) = 1.

Statistical analysis:

Data were analyzed using analysis of variance and mean separations calculated by procedure of the statistical analysis system (SAS, 1988). Duncan multiple ranges at 5% level of significance was used to compare between means. Results were followed by different alphabetical letters significantly differed (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical analysis:

Results of the proximate chemical constituents of seed, full- fat and defatted flours of lupine and chickpea are presented in Table (1). The dry matter percentages of lupine seed, full- fat and defatted flours were 92.55, 94.15 and 94.57%, respectively. These values slightly changed in chickpea samples. Protein content of lupine seeds, full-fat and defatted flours recorded higher percentages compared to chickpea. Also, the data revealed that defatted flours of lupine and chickpea gave higher protein compared to seed or full-fat flours. The calculated nitrogen free extract indicated that, lupine and chickpea defatted flours had the highest values followed by seed and full-fat flours, respectively. These findings are in agreement with Sathe *et al.*, (1982); Bencini (1986).

Table (1): Proximate chemical constituents of seed, full-fat and defatted flours of lupine and chickpea (dry weight basis).

Samples	Dry matter	Protein	Lipids	Ash	*NFE
Lupine:					
Seeds	92.55	40.14	11.75	3.12	44.99
Full- fat flour	94.15	46.34	13.67	3.25	36.74
Defatted flour	94.57	53.35	2.57	5.11	38.97
Chickpea:					
Seeds	91.24	18.18	9.31	2.89	69.62
Full- fat flour	93.68	21.33	11.92	3.24	63.51
Defatted flour	94.17	24.22	2.64	4.26	68.88

*Nitrogen free extract calculated by difference

Functional Properties:

Recently, attention has been directed towards the utilization of different protein sources including plant proteins as proteinaceous ingredient depends largely upon the beneficial qualities they import to foods. Actually, the functional properties of any protein material detect the accepted way for utilization and also the quantities to be used in food preparation. The functional properties which include foam capacity and stability; water absorption, protein solubility and emulsifying capacity and stability are of great importance and attributed to the protein components.

Water Absorption:

Results of water absorption of defatted chickpea and lupine flours at different temperatures and pH values are presented in Table (2) .The obtained data indicated that water absorption of lupine flour was higher than that of chickpea flour at all pH values and different temperatures. It increased from 314 to 519, 310 to 472 and 363 to 597g water/100g defatted flour at 4°C, 25°C and 70°C, respectively at pH all values. Generally, it could be observed that water absorption was affected by pH values and temperatures, their values increased with increasing of pH values and temperatures. These data were in accordance with Jones and Tung, (1983). They reported that proteins are capable of binding large quantities of water because of their ability to form hydrogen bonds between water molecules and polar chains and pH affects the magnitude of the net charge on protein molecules, which in turn alter the attractive and repulsive interaction.

Concerning heat treatment at 70°C, it is evident that water absorption values increased. This was supported by the results of Fiora *et al.* (1990). They reported that water absorption could be affected by water physically entrapped within unfolded protein and by different degree of denaturation. Also, Narayana and Narasinga Rao, (1982) reported that heat processed winged bean flour had higher water absorption capacity than the raw flour. Also, protein denaturation, starch gelatinization and swelling of the crude fiber, which may occur during heat treatment, could all be responsible for the increased water absorption values. But, water absorption is not improved or enhanced in all flour samples processed at 4°C, compared to the other treatments.

Table (2): Water absorption (g water /100 g) of defatted chickpea and lupine flours at different pH values and temperatures.

pH values	4°C		25°C		70°C	
	*C	*L	*C	*L	*C	*L
2	190	310	226	314	311	363
4	221	347	234	357	325	468
** 5.46	230	374	243	396	328	398
6	234	429	256	446	335	512
8	242	450	260	488	343	559
10	249	472	279	519	352	597

Where *C= Chickpea flour, *L= Lupine flour, **Original pH values

Foam Capacity and Stability:

Foam capacity and stability as function of pH in defatted chickpea and lupine flours are reported in Table (3). Chickpea Flour gave a higher foam capacity than lupine flour, Also, foam capacity was increased at pH 6.0 compared to other pH values, indicating that foam properties were inversely related to protein solubility and the greatest foam ability is due to electrostatic interaction that probably involved in film formation, and more protein adsorbed at the interface, resulted in maximal reduction of surface tension.

On the other hand, chickpea flour exhibited less foam stability than lupine flour at all pH values, Complete collapse of the foam was observed for chickpea flour at pH values (from 5.46 to 10.0), after 15 min. at room temperature and all pH values when standing at room temperature for 30 min. till 60 min., because the film formation was limited and showed no ability to form a foam or formed unstable foam with a big air bubbles surrounded by weak surface film which tended to coalescence and disappeared after 15 minutes at room temperature. Also, the poor ability to form foam due to the loss of soluble low molecular weight protein. The obtained data agrees with Bencini (1986).

Table (3):Foam capacity and stability of dispersion of defatted chickpea and lupine flours at different periods (min.) and pH values

pH values	Foam capacity		Foam Stability at different periods				
			15 min.		30 min.		60 min.
	*C	*L	*C	*L	*C	*L	*L
2	83	65	45	65	0	65	65
4	92	60	45	39	0	30	Tracs
** 5.46	90	71	0	0	0	0	Tracs
6	98	81	0	37	0	21	Tracs
8	47	42	0	27	0	Tracs	Tracs
10	76	62	0	36	0	Tracs	Tracs

Where *C= Chickpea flour, *L= Lupine flour, **Original pH values

Nitrogen Solubility:

Protein solubility is a critical property for applications and in fact, is used diagnostically to asses prior heating and to determine the potential usefulness of various food applications. At the start nitrogen solubility Index determination at pH 2.0 was high in lupine flour than chickpea flour at 25°C and 70°C. It decreased by increasing pH value, but still less than the start point in chickpea flour but higher than start point in lupine flour at pH 10.0.

The nitrogen solubility index profile (Fig.1) of chickpea and lupine flours indicated that the minimum nitrogen solubility index was at pH 5.46 for chickpea flour and at pH 4.0 for lupine flour, then increased with increasing pH values. These finding coincided with those obtained by Sathe *et al.*, (1982); El-Adawy *et al.,* (2001) for lupine flour. Similar observations were also recorded by Bencini, (1986) for chickpea flour.

Regarding to Fig. (1). It was clearly noticed that lupine flour gave considerably higher nitrogen solubility index at all pH values than chickpea flour. The values ranged between 52.2 to 76.92 and from 42.7 to 36.37 at PH 2.0 to 10.0 at 25°C of lupine and chickpea flour, respectively. In addition, heat treatments at 70°C for 30min. improve the solubility of defatted flours. Generally, the degree of solubility of a protein in a given aqueous system is due to net formation from both electrostatic and hydrophobic interactions between the protein molecules, conditions under which the electrostatic repulsions interact between the molecules is greater than the hydrophobic interactions between the non-polar patches on the surface thus favors increased solubility.

Also, conversely, conditions under which the hydrophobic interactions are greater than electrostatic repulsions will result in intermolecular changes during commercial preparations, which result in irreversible changes in the algometric state of the protein, would alter the delicate balance of the above two forces and thereby affects the solubility (Damodaran and kinsella, 1982). Low solubility is not always a disadvantage and many protein of limit solubility find uses in the production of foods (Hermansson, 1979).

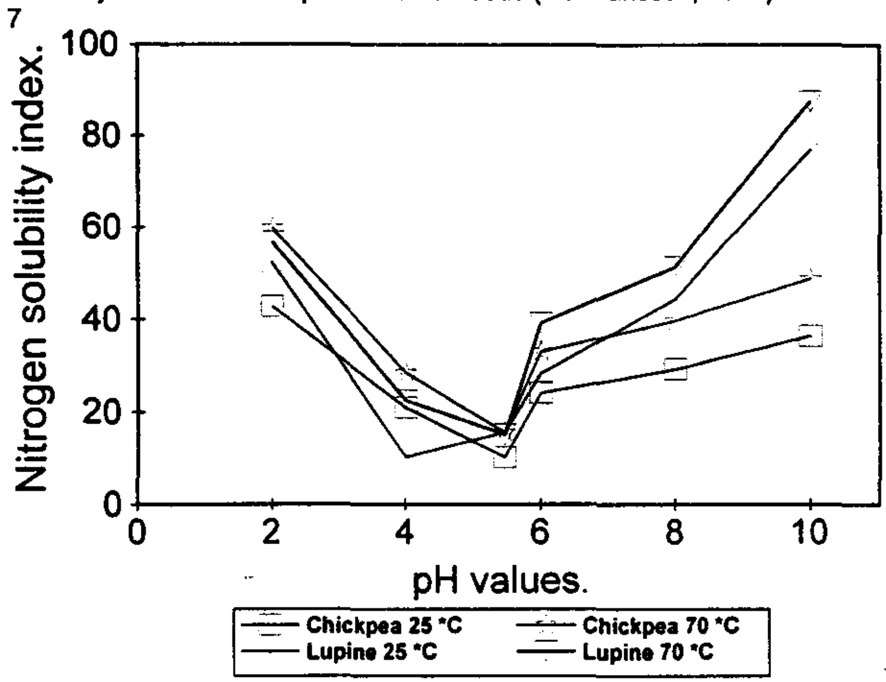

Fig. (1): Nitrogen solubility index of defatted chickpea and lupine flours at different pH values.

Emulsion Activity and Stability:

Solubility of protein is an important prerequisite for emulsifying properties of protein. This is reflected in the correlation between emulsifying capacity and protein solubility. The effect of pH on emulsion, manly emulsion tends to be significantly lower in the isoelectric range. In the same emulsion systems, this relationship is not always apparent because of the high concentration of protein used (Kinsella *et al.,* 1985).

Emulsion activity and stability of defatted chickpea and lupine flours at different pH values and times (min.) are presented in Table (4). Emulsion activity and stability up to 60min. was pH dependent. The Emulsion activity and emulsion stability were high at the beginning at pH 2 then decreased by increasing pH to 4 in all treatments. The emulsion activity gradually increased with increasing pH values from 4 to 10, emulsion activity values for chickpea and lupine flours ranged from 24.4 to 69.6 and 33.2 to 103.9 at pH values ranged between 4 to 10, respectively. In addition, it was clearly noticed that lupine flour characterized by the highest emulsion activity compared to chickpea flour. In general, shifting the pH away from the isoelectric point, (5.46) apparently improved emulsion activity by giving the protein an electrical charge and possibly increasing the protein s solubility.

Results of emulsion stability of the chickpea and lupine flours are recorded in Table (4). Generally, the samples registered the highest emulsion stability at both acidic and alkaline pH values after standing 60 minute. The greatest emulsion stability of a protein is not necessarily associated with the highest level of soluble protein (McWatters and Holmes, 1979; Turgeon *et al.*, 1992). In conclusion, the lupine and chickpea flour had the highest emulsion stability at alkaline pH values. Improving emulsion properties of lupine and chickpea flour may enhance their uses as functional ingredients in many foods.

Table (4): Emulsification activity and emulsion stability indices (m^2/g protein) of defatted chickpea and lupine defatted flours at different times and pH values.

pH values	Emulsification activity		Emulsion stability at different periods (min.) 20 min.		40 min.		60 min.	
	*C	*L	*C	*L	*C	*L	*C	*L
2	45.0	36.1	35.7	36.8	30.2	36.5	29.1	36.5
4	24.4	33.2	21.4	31.0	19.2	31.0	18.8	30.8
** 5.46	56.4	37.3	43.1	36.8	33.9	36.1	31.7	35.4
6	51.2	67.4	50.1	30.2	47.5	29.8	44.2	27.9
8	59.3	71.9	59.3	64.9	56.6	62.6	57.9	60.1
10	69.6	103.9	66.7	99.1	62.6	97.3	62.6	93.6

Where *C= Chickpea flour, *L= Lupine flour, **Original pH values

Cooking Characteristics:

Cooking yield:

The cooking characteristics such as cooking yield, cooking loss and shrinkage of beef patties were determined. The results in Table (5) show that gradual increases in cooking yield of beef patties samples by increasing the percentage of either hydrated lupine or chickpea flours. Their values being 66.7% in full meat patty and reached the maximal 84.4% and 80.3 for patties contained lupine or chickpea flours at 35 % substitution and cooked at 180°C, respectively. Also, cooking yield and cooking loss were affected by the cooking methods, as seen in Table (5), microwave gave the lowest cooking yield compared to broiling process, of beef patties prepared from lupine or chickpea hydrated flours, at substitution levels ranged from 10 to 35%.

It was clearly noticed that using hydrated lupine flours greatly improved the cooking yield of beef patties than the beef patties prepared from chickpea hydrated flours and cooked by using broiling or microwave treatments. The yield values ranged from 72.2% to 84.4% and from 69.4 to 81.8, after cooking using broiling at 180°C and microwave treatments, respectively at the minimal to maximal substitution levels (10% and 35%).

With respect to the reduction in shrinkage percentages (Fig.2) and cooking loss Table (5) of beef patties, results indicated that there is inverse relationship between both of the shrinkage and cooking loss with substitution percentages. Beef patties prepared with adding hydrated lupine or chickpea flours had lower shrinkage and cooking loss than patty prepared without adding flours (full meat patty). The data also, show that the obtained differences in shrinkage and cooking loss probably due to difference in period of cooking.

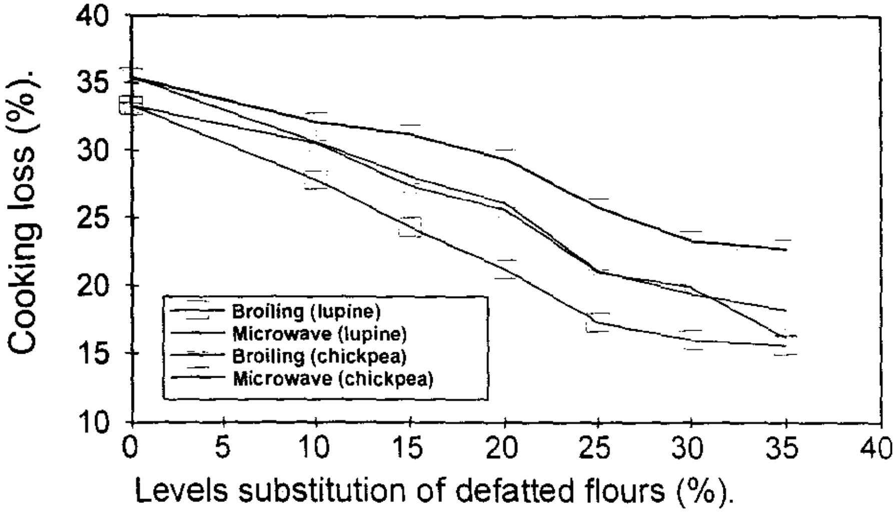

Fig. (2): Cooking loss of beef Patties substituted with lupine or chickpea flour and cooked by broiling and microwave.

Table (5): Cooking yield and shrinkage (%) of cooked beef patties substituted with lupine or chickpea defatted flours.

Treatments	Cooking characteristics	Substitution levels of hydrated Flour %						
		Control	10	15	20	25	30	35
				Lupine Flour				
B	Cooking Yield	66.7	72.2	75.7	78.8	82.7	84.0	84.4
	Shrinkage	27.7	26.0	24.6	21.8	18.7	16.3	16.0
M	Cooking Yield	64.6	69.4	71. 9	73.9	78.9	80.6	81.8
	Shrinkage	30.8	28.6	25.1	24.1	22.7	22.1	20.7
				Chickpea Flour				
B	Cooking Yield	66.7	69.5	72.6	74.4	79.0	80. 1	80.4
	Shrinkage	27.7	27.4	26.3	25.0	24.6	20.5	18.7
M	Cooking Yield	64.6	67.9	68.8	70.6	74.2	76.7	77.3
	Shrinkage	30.8	29.3	27.1	25.8	23.9	23.3	22.8

B= broiling M= microwave

The beef patties contained hydrated defatted lupine or chickpea flours and cooked using microwave gave shrink (%) more than their corresponding samples cooked by broiling method. This observation may be refereed to the nature of the microwaves itself in that they penetrate inside the food, exciting all water molecules at the same time, breaking their hydrogen bond and resulting in the rapid cooking and intensive simultaneous evaporation and drip losses.

In addition, results recorded in table (5) revealed that beef patties contained hydrated lupine flours gave lowest shrinkage and cooking loss at all substitution levels (10 to 35%) compared to other patty samples. This observation probably due to the function role of hydrated flours in reducing the rate juice loss during cooking. The above-mentioned findings agree with those reported by Jen *et al.*, (1999); Prabhakara and Janardhana (2000). They mentioned evaluated the degree of shrinkage is important as criteria in maintaining quality standards of beef patties prepared in food service establishments. Therefore, changes in diameter and thickness must be considered with suitable of meat additives.

Sensory Quality Evaluation:

Sensory quality attributes of control patty (all meat) and those substituted with hydrated flour of lupine or chickpea are presented in Table (6 and 7). All meat patties and those containing 10,15,20 and 25% hydrated flour then cooked by broiling or microwave process, were not significantly different in color. As hydrated flour increased, however, differences increased between the patties in color, especially in patties substituted with higher levels (30 and 35%) of lupine flour and for those substituted with chickpea flour and cooked using microwave, patty samples had significantly lower color ratings. Patties containing15. 20 and 25% hydrated flour samples gave a best Juiciness scores after cooking by broiling or microwave treatments. The differences were significantly of those containing 25% and all substitution levels of hydrated flour.

Table (6): Sensory Quality Evaluation of Cooked Patties Contained Defatted Lupine Flour

	Substitution hydrated Flour %	Color	Texture	Juiciness	Flavor	Overall acceptability
Broiling	Control	5.0^{A}	5.0^{F}	5.0^{C}	5.0^{B}	5.0^{E}
	10	5.0^{A}	5.0^{F}	5.0^{C}	5.3^{AB}	5.4^{DC}
	15	5.0^{A}	5.9^{DE}	5.4^{CAB}	5.7^{A}	6.9^{A}
	20	5.0^{A}	6.4^{CDE}	5.9^{AB}	5.4^{AB}	6.0^{CB}
	25	5.0^{A}	6.9^{AB}	6.0^{A}	5.4^{AB}	5.4^{DCE}
	30	4.7^{AB}	7.3^{A}	5.4^{CAB}	5.3^{AB}	5.0^{E}
	35	4.0^{B}	6.9^{AB}	5.3^{CB}	4.0^{C}	3.7^{F}
Microwave	10	5.0^{A}	5.4^{FE}	5.0^{C}	5.1^{AB}	5.4^{DCE}
	15	5.0^{A}	6.1^{CDB}	5.0^{C}	5.3^{AB}	6.3^{AB}
	20	5.0^{A}	6.3^{CDB}	5.7^{AB}	5.4^{AB}	5.7^{DCB}
	25	5.0^{A}	6.4^{CDB}	5.9^{AB}	5.7^{A}	5.7^{DCB}
	30	4.7^{AB}	6.7^{CAB}	5.0^{C}	5.0^{B}	5.3^{DE}
	35	3.7^{C}	6.0^{CD}	5.0^{C}	4.0^{C}	4.3^{F}

Control =All meat patties.

Table (7): Sensory Quality Evaluation of Cooked Patties Contained Defatted Chickpea Flour

	Substitution hydrated Flour %	Color	Texture	Juiciness	Flavor	Overall acceptability
Broiling	Control	5.0^AB^	5.0^F^	5.0^C^	5.0^B^	5.0^F^
	10	5.0^AB^	5.3^FE^	5.0^C^	5.0^B^	5.7^EFD^
	15	5.0^AB^	5.7^CDE^	5.6^CAB^	5.0^B^	6.1^AB^
	20	5.0^AB^	6.1^CDB^	6.0^A^	5.3^AB^	7.9^A^
	25	5.0^AB^	6.3^CAB^	6.0^A^	5.3^AB^	6.0^CD^
	30	5.0^AB^	6.6^AB^	5.3^CB^	5.3^AB^	5.0^EFD^
	35	5.0^AB^	6.4^AB^	5.0^C^	4.3^C^	4.0^G^
Microwave	10	5.0^AB^	5.3^FE^	5.0^C^	5.0^B^	5.7^EFD^
	15	5.0^AB^	5.6^FDE^	5.6^CAB^	5.0^B^	5.9^ECD^
	20	5.3^A^	5.7^CDE^	5.7^AB^	5.6^A^	6.7^CD^
	25	5.0^AB^	6.0^CDB^	6.0^A^	5.4^AB^	5.9^ECD^
	30	4.4^CB^	6.6^AB^	5.3^CB^	5.3^AB^	5.1^EF^
	35	4.3^C^	6.9^A^	5.1^CB^	3.9^C^	3.6^G^

Control =All meat patties.

No significant differences in flavor characteristic could be observed for the patty samples containing hydrated flours, however, the cooked patties samples substituted with 35% of lupine or chickpea flour had the lowest flavor ratings than the other samples. Concerning texture, all cooked patties contained hydrated flour had better texture compared to patty prepared without addition of flour. There are significant differences between control patty and other patties substituted with flours. The same observations denote overall acceptability of beef patties with hydrated flours. Finally, this study shows a possibility of using hydrated flours as a one of the main ingredients in such functional blends that might be useful in producing extended meat products, similar observations were found by McClenahan *et al.*, (2001); Hoda *et al.*, (2002).

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الخصائص الوظيفية لدقيق الحمص والترمس وتطبيقة فى البيف باتيه

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يهـدف هذا البحث إلى تقييم الخصائص الوظيفية للدقيق المنزوع الدهن والمعد من بذور الحمص والترمس. وذلك لتطبيقية بنسب محدده في إنتاج البيف باتيه منخفض في المحتوى الدهنى، وبناء على ذلك تم دراسة تأثر هذه الخصائص بقيم ألأس الأيدروجينى (من ٢ الى١٠) وبدرجات الحـرارة المخـتلفة. وتـضمنت الدراسة أيضا تأثير إضافة الدقيق المأدرت على خصائص جودة الطبخ باستخدام الفرن العادي أو فرن الميكروويف.

أظهـرت الدراسة أن دقيق الترمس المنزوع الدهن احتوى على نسبة بروتين أعلى وأن كمية المـاء الممتـصة كانت مرتفعة مقارنة بدقيق الحمص وعند معاملة عينات كل من دقيق الترمس والحمص على درجة حرارة ٧٠ °م لمدة ٢٠ دقيقة أظهرت تحسنا في القدرة على امتصاص الماء . كما أتضح من الدراسة أن دقيق الحمص سجل كمية رغوة كبيرة ولكن قدرتها على الثبات كانت منخفضة.

ولقـد دلـت النتائج أن قيم معامل النيتروجين الذائب انخفضت عند ألأس الأيدروجينى ٤,٠ لدقيق الترمس ، ٤,٤٦ للحمص ، ثم تزايدت هذه القيم بزيادة قيم الأس الأيدروجينى. كما لوحظ أن دقـيق التـرمس سـجل أعلى قيم لمعامل النيتروجين الذائب مقارنة بدقيق الحمص وأن هذه القيم ارتفعـت بالمعاملة على درجة حرارة ٧٠ °م لمدة ٢٠ دقيقة. وبالإضافة إلى ذلك وجد أن القدرة الاسـتحلابية لدقيق الترمس عالية وأن المستحلب الناتج أكثر ثباتا في الوسط الحامضى والقاعدي على فترات زمنية مختلفة.

مـن نـتائج دراسـة خصائص جودة الطبخ للبيف باتيه ، وجد أن قيم ناتج الطبخ في الفرن العـادي أو فـرن الميكروويف تتزايد بزيادة نسب الاستبدال بالدقيق المأدرت ، وأن هناك علاقة عكسية بين نسبة كل من الانكماش والفقد بعد الطبخ .و أتضح من نتائج التحليل الحسي ، أن اللون يتأثـر بـزيادة نسب الاستبدال بالدقيق وأن هناك فروق معنوية عند ٣٠ ، ٣٥ % ، كما تحسنت خاصية العصيرية للبيف باتيه المحتوى على دقيق مأدرت مقارنة بعينة المقارنة . وبالنسبة للرائحة والطعم لا توجد فروق معنوية بين عينات البيف باتيه المضاف له دقيق ترمس أو حمص باستثناء العيـنات التـي احـتوت علـى ٣٥ % . وبالتالي نستخلص من الدراسة أنه يمكن إضافة دقيق الترمس أو الحمص المأدرت المنزوع الدهن بنسب مقبولة حسيا ولم يوجد فروق معنوية حتى ٣٠ % فـي تـصنيع البـيف باتيه المنخفض في نسبة الدهن وذات خواص حسية وجودة عالية لدى المستهلك .