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EFFECT OF SOAKING MEDIUM ON ORGANOLEPTIC PROPERTIES, CHEMICAL COMPOSITION AND SOME ANTINUTRITIONAL FACTORS OF PARCHED CHICKPEA (*Cicer arietinum* L.)

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ABSTRACT

To assess a safe method for parching chickpea **,** different soaking media included $NaHCO_3$, Na_2CO_3 , NaOH were used in comparison to commercial lime ($Ca(OH)_2$) . Three concentrations (i.e. 5 , 10 and 15 %) were prepared from each of aforementioned media. Soaking of chickpea was carried out for 15 min at room temperature . The drained seeds that air dried for 24 hr at room temperature were parched at 240^0C for 1 min . Different parched chickpea samples along with 3 traditionally parched samples were applied for sensory evaluation , proximate chemical composition , heavy metals (Pb , Co , Cd) , antinutritional factors (trypsin inhibitor, phytic acid and tannins). Generally , data for the aforementioned determinations varied significantly as affected by different treatments .

Data also showed that parched chickpea treated with commercial lime along with market samples had the highest contents of ash and heavy metals with Pb content over the recommended limit besides the high content of antinutritional factors mainly phytic acid . It is concluded that using $NaHCO_3$ (up to 15 %) , instead of commercial lime , resulted in acceptable parched chickpea from organoleptic properties , safety and nutritional point of view .

Keywords: Chickpea, soaking , parching , organoleptic properties , chemical composition , heavy metals , trypsin inhibitor , phytic acid , tannins .

INTRODUCTION

Chickpea , *Cicer arietinum* L. (also known as Bengal gram , boot , chana chola , chola , grem , hommes and poischiche) is globally the third most important pulse crop after navy beans and dry beans **.** the subspecies *arietinum* is divided into two distinct types (i.e , Kabuli or Garbanzo type and Desi type). Kabuli chickpeas are of Mediterranean and Middle Eastern origin (Petterson *et al* , 1997) **.** Soaking of dried chickpea , sprouting , fermenting, boiling, steaming, roasting, parching, puffing and pureeing are commonly used to convert them into a consumable form **.** Dried chickpea is also an ingredient in a variety of snack foods, sweets and condiments (Robinson and Singh , 2001) **.**

Chickpea is one of the major legume crops in Egypt which comes after faba bean and lentil as a good source of protein. Two main varieties of chickpea , called balady (Giza 2) and shamy (Giza 1) are well known in Egypt. The former one is usually consumed in the form of parched chickpea while the later as cooked chickpea . The parched chickpea has an attractive golden – yellow colour, a porous texture and a pleasant taste **.** It is usually used around the year particularly during the Moslem Saint's festivals (*Moulid*) and in other occasions such as the 7th day after delivery (*Soboa*). It is also consumed as a snack between meals and in the preparation of various confectioneries (Abdel – Aal and Attia , 1993).

$Ca(OH)_2$ parching treatment is a well known commercial process in Egypt , in which the raw chickpea is soaked in commercial lime solution (up to 40 %) for a short time , then parched at 240 ^{o}C for about 1 min (Attia, 1992). Although utilization of such impure chemical in food processing is forbidden , notwithstanding , in Egypt some processors specially who prepare parched chickpea , in an attempt to minimize the cost of processing and as a tradition , tend to use a cheap commercial grade of lime that is widely used for industrial purposes in parching chickpea (Ziena *et al* , 1997) . Moreover, it was reported that using of such commercial lime in parching chickpea resulted in a significant increase in lead content over its recommended limits (Abdel –Aal and Attia , 1993) .

It is well known that presence of antinutritional factors (e.g. trypsin inhibitors , phytic acid and tannins) is one of the main drawbacks limiting the nutritional and food qualities of chickpea and other legumes (Singh and Jambunathan , 1981 ; Khokhar and Chauhan , 1986 and Liener , 1989) . No information concerning a safe method for parching chickpea is available .Therefore , the present study was carried out to establish a simple and safe procedure for parching chickpea instead of using commercial lime and evaluate it in terms of sensory evaluation , chemical composition , heavy metals (Pb , Co and Cd) and antinutritional factors (trypsin inhibitors , phytic acid and tannins) .

MATERIALS AND METHODS

Raw chickpea sample (12kg) along with representative 3 parched chickpea samples (1 kg each) , in the day of parching , were purchased from well known parching shops in Tanta city, El- Gharbia Governorate, Egypt.

Commercial lime sample (2 kg) were purchased from one of commercial lime store in Alexandria, Egypt . Sodium bicarbonate ($NaHCO_3$), sodium carbonate (Na_2CO_3) and sodium hydroxide (NaOH) are chemically pure (ADWIC, EL-Nasr Pharmaceutical Chemicals, Egypt).

Parching process:

The traditional commercial procedure that applied at local parching shops in Egypt (Fig.1) was followed to prepare parched chickpea.

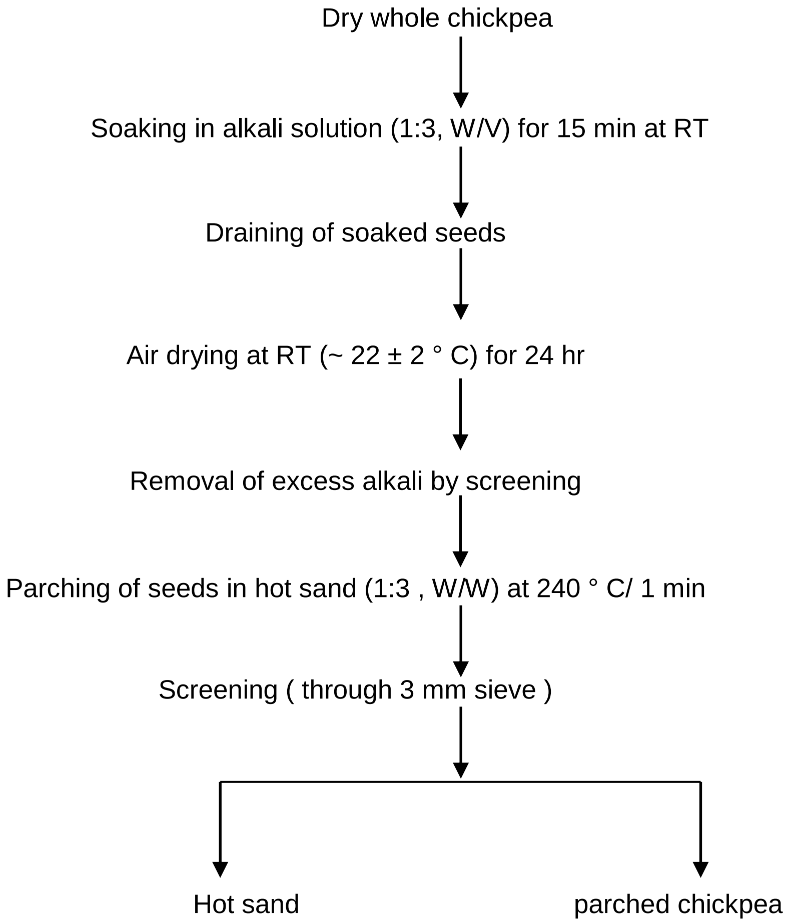

Fig. 1 : Flow sheet for preparing parched chickpea .

Different soaking media were carried out as follows:

Treatment No.	Soaking medium	pH
1	Without soaking	-
2	Dist. water	6.65
3	$NaHCO_3$ 5%	8.07
4	$NaHCO_3$ 10%	8.23
5	$NaHCO_3$ 15%	8.51
6	Na_2CO_3 5%	8.30
7	Na_2CO_3 10%	8.58
8	Na_2CO_3 15%	8.80
9	NaOH 5%	11.33
10	NaOH 10%	12.05
11	NaOH 15%	12.46
12	Commercial lime 5%	11.12
13	Commercial lime 10%	11.66
14	Commercial lime 15%	11.84

Three batches were carried out for each treatment (250 g each).

Organoleptic properties.

Different parched chickpea samples understudy along with the three commercial samples were presented simultaneously to a panel of 10 panelists. The panelists were asked to rank each sample on the hedonic scale of 1 (very poor); 2-4(poor); 5-6 ((fair); 7-8 (good); and 9-10(excellent) for each of colour, flavour, texture and overall acceptability.(Moskowitz, 1974).

Analytical Methods

Raw and parched chickpea seeds were analyzed by the standard method of AOAC(1995) for moisture), crude protein, crude fat, total ash and crude fiber . N-free extract was calculated by difference . The ash of each sample was used for the determination of heavy metals. Ash was dissolved in 5 ml of 6N HCl, heated to boiling, cooled, filtered into 25 ml volumetric flask through whatman No.42 ashless paper and diluted to the final volume with deionized water. Lead (Pb), Cobalt (Co) and Cadmium (Cd) were determined using Perkinelmer atomic absorption spectrophotometer (AOAC , 1995) .

Trypsin inhibitor activity was determined spectrophotometerically (Roy and Roa, 1971), using trypsin (Serva, from bovine pancreas, 40 U/mg) and casein as substrate. Corresponding blanks were run concurrently. Absorbance was read at 280 nm using LKB Biochrom Ultrospec 4050. One trypsin unit was arbitrarily defined as an increase of 0.01 absorbance unit at 280 nm in the 10 ml incubated reaction mixture and the trypsin inhibitor activity as the number of trypsin inhibited. Phytic acid was determined according to the method of Thompson and Erdman(1982). Phytate-P values were converted into phytate by assuming it contained 28.2% P (Brooks and Morr, 1984). The vanillin method (Khokhar and Chauhan, 1986) was used to determine tannins in methanol extracts and the absorbance of the developed colour was measured at 500 nm. Catechin was used as a reference standard.

Statistical analysis:

The data were statistically analyzed by standard method of analysis of variance and mean separation was determined using Duncan's multiple range test . Correlation coefficient was also determined as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Organoleptic properties

Data for organoleptic properties of different parched chickpea simples are presented in Table 1. It was clear that different between colour of all treatment where significant ($p < 0.05$). However , the colour of parched chickpea treated with commercial lime up to 10% along with market samples were the superior (golden – yellow colour) followed closely with that treated with $NaHCO_3$, While the other treatments i.e. Na_2CO_3 and NaOH resulted in dark yellow (fair) and brown (poor) chickpeas, respectively . The same type of data are shown for both flavour and texture of parched chickpea samples. Sodium hydroxide negatively affected the chickpea flavour and texture considerably as ranked from fair (at 5%) to poor (at 15%) . The rejection mainly resulted from the development of bitter to alkali taste with rigidity. The point of interest was that the flavour as well as texture of parched chickpea treated with 5% and 10% $NaHCO_3$ was more or less the same as the lime-treated and market samples . Concerning the overall acceptability, it was noticed that treatment of chickpea with $NaHCO_3$ resulted in parched chickpea closely comparable to commercial lime samples. There was evidence that , as would be expected , overall acceptability correlated significantly with colour (r = 0.976**) and flavour (r = 0.971**) more than the texture itself (r = 0.915**).

Table(1): Organolyptic properties of parched chickpea samples*.

Treatment		Colour (out of 10)	Flavour (out of 10)	Texture (out of 10)	Overall acceptability (out of 10
Without soaking		6.2 ± 0.4^{e}	6.5 ± 0.3^{ef}	5.4 ± 0.4^{fg}	6.2 ± 0.4^{cd}
Dist. water		5.5 ± 0.2^{fg}	6.8 ± 0.3^{d}	5.3 ± 0.2^{g}	6.0 ± 0.2^{d}
$NaHCO_3$	5 %	7.9 ± 0.3^{d}	7.7 ± 0.4^{bc}	7.6 ± 0.4^{bc}	7.9 ± 0.3^{ab}
	10%	7.8 ± 0.4^{d}	7.9 ± 0.2^{ab}	7.8 ± 0.3^{ab}	7.8 ± 0.3^{ab}
	15%	7.9 ± 0.4^{d}	7.4 ± 0.3^{c}	7.3 ± 0.3^{c}	7.5 ± 0.2^{b}
Na_2CO_3	5%	5.6 ± 0.3^{f}	6.3 ± 0.3^{f}	6.6 ± 0.4^{d}	5.6 ± 0.3^{ef}
	10%	5.2 ± 0.4^{gh}	6.8 ± 0.4^{de}	6.0 ± 0.3^{e}	5.8 ± 0.3^{de}
	15%	5.9 ± 0.3^{ef}	6.2 ± 0.4^{f}	5.9 ± 0.3^{ef}	5.2 ± 0.2^{fg}
NaOH	5%	4.8 ± 0.4^{h}	5.2 ± 0.3^{g}	5.5 ± 0.4^{fg}	4.9±0.3g
	10%	4.3 ± 0.4^{i}	4.4 ± 0.4^{h}	5.4 ± 0.3^{fg}	4.1 ± 0.3^{h}
	15%	3.6 ± 0.3^{j}	3.7 ± 0.4^{i}	3.8 ± 0.3^{h}	3.5 ± 0.4^{i}
Commercial lime	5%	8.8 ± 0.6^{a}	7.8 ± 0.2^{bc}	8.1 ± 0.4^{a}	8.0 ± 0.2^{ab}
	10%	8.3 ± 0.3^{bc}	8.2 ± 0.2^{ab}	8.3 ± 0.3^{a}	8.2 ± 0.2^{a}
	15%	6.4 ± 0.3^{e}	6.8 ± 0.4^{d}	6.3 ± 0.3^{de}	6.7 ± 0.3^{c}
Market sample	A	8.0 ± 0.4^{cd}	8.1 ± 0.3^{ab}	8.2 ± 0.4^{a}	8.0 ± 0.4^{ab}
	B	8.5 ± 0.3^{ab}	8.0 ± 0.3^{ab}	8.0 ± 0.4^{ab}	8.2 ± 0.3^{a}
	C	8.3 ± 0.3^{bc}	8.4 ± 0.2^{a}	8.3 ± 0.4^{a}	8.3 ± 0.3^{a}

*** Means ± SD in a column not sharing the same superscript are significantly different at $P\leq 0.05$.**

Proximate chemical composition

The effect of different treatments on the chemical composition of parched chickpea is presented in Table 2. Parching of chickpea significantly reduced the moisture content. However, the moisture content of the resultant parched chickpea became between 4.10% and 6.01% .The point of interest was that increasing the concentration of alkali resulted in a significant increase in moisture content of the resultant parched chickpea (r = 0.970**). It well known that moisture content is a key factor in shelf life of such products . The lower moisture content of parched chickpea , the long shelf life is .

Generally, the crude protein content decreased significantly by parching process except applying Na_2CO_3 in accordance to data published by Kamel (1984). The degree of reduction was correlated with the increment of alkali level mainly commercial lime and $NaHCO_3$ rather than the other chemicals understudy . However, the protein content, 24.13 % in raw chickpea , became between 22.13 - 23.86% as affected by parching . The most pronounced reduction (up to 8.8% of the total protein) was for applying both NaOH and commercial lime in contrary to that parched using $NaHCO_3$ and Na_2CO_3. Kamel (1984) found that crude protein content decreased noticeably on parching chickpea mainly on globulin fraction rather than albumin one and on legumin rather than viciline fraction .

Table 2: Proximate chemical composition (%, on dry wt. basis) of raw and different parched chick pea samples*.

Treatment		Moisture	Crude protein	Fat	Ash	Crude Fiber	N-free extract
Raw		9.87±0.35^{a}	24.13±0.88^{a}	6.06±0.30^{d}	2.51±0.06^{j}	5.12±0.11^{a}	62.18
Without soaking		4.95±0.17^{i}	24.07±0.92^{a}	6.31±0.22^{b}	2.55±0.12^{j}	5.06±0.17^{a}	62.01
Dist. water		5.60±0.20^{de}	23.78±0.33^{ab}	6.38±0.10^{ab}	2.43±0.01^{j}	5.18±0.21^{a}	62.23
$NaHCO_3$	5 %	4.10±0.17^{k}	23.81±0.52^{ab}	6.21±0.13^{c}	2.67±0.04^{i}	4.89±0.18^{b}	62.42
	10%	4.13±0.15^{k}	23.48±0.77^{b}	6.18±0.07^{c}	2.73±0.03^{hi}	4.72±0.25^{c}	62.89
	15%	4.59±0.20^{j}	23.21±0.63^{c}	6.24±0.11^{c}	2.79±0.02^{gh}	4.61±0.20^{de}	63.15
Na_2CO_3	5%	5.14±0.21^{h}	23.65±0.51^{b}	6.18±0.14^{c}	2.70±0.04^{hi}	4.80±0.17^{bc}	62.67
	10%	5.35±0.18^{fg}	23.86±0.42^{ab}	6.25±0.08^{c}	2.88±0.04^{g}	4.68±0.23^{cd}	62.33
	15%	5.51±0.20^{ef}	23.77±0.66^{ab}	6.30±0.12^{b}	2.97±0.04^{f}	4.62±0.15^{de}	62.34
NaOH	5%	5.72±v0.23^{cd}	22.38±0.70^{de}	6.33±0.19^{ab}	2.73±0.05^{hi}	4.60±0.18^{de}	63.96
	10%	5.85±v0.20^{bc}	22.13±0.46^{ef}	6.21±0.21^{c}	2.90±0.03^{fg}	4.57±0.22^{e}	64.19
	15%	5.35±0.21^{f}	22.17±0.38^{ef}	6.29±0.17^{bc}	2.99±0.01^{f}	4.40±0.20^{gh}	64.15
Comm.lime	5%	4.58±0.19^{j}	22.54±0.75^{d}	6.23±0.20^{c}	3.30±0.04^{e}	4.68±0.16^{c}	63.25
	10%	4.90±0.24^{i}	22.37±0.60^{de}	6.37±0.13^{a}	3.59±0.03^{d}	4.50±0.11^{f}	63.17
	15%	5.35±0.21^{f}	22.01±0.77^{f}	6.28±0.16^{bc}	3.82±0.07^{b}	4.37±0.14^{h}	63.52
Market	A	5.51±0.11^{ef}	23.28±0.66^{c}	6.18±0.12^{c}	4.01±0.14^{a}	4.22±0.18^{i}	62.31
	B	5.28±0.20^{gh}	22.91±0.58^{c}	6.46±0.11^{a}	3.72±0.12^{c}	4.48±0.11^{fg}	62.43
	C	4.86±0.12^{i}	23.08±0.78^{c}	6.28±0.16^{bc}	3.85±0.07^{b}	4.55±0.11^{ef}	62.24

*** Means ± SD in a column not sharing the same superscript are significantly different at $P \leq 0.05$.**

Data concerning fat content of different parching chickpea samples (Table 2) showed a marked increase on parching . However, the different treatments had more or less the same fat content which reflects the parching process itself as the main reason of such increase rather than the type of soaking medium . It well known that processors used to add a small portion of edible oil (~ 25 gm / Kg sand) to increase the efficiency of parching , to improve the appearance of parched chickpea (golden yellow) as well as to eliminate the development of chalky surface defect that may occur on drying alkali treated hulls .

Ash contents of different chickpea samples increased and varied significantly on parching . It was clear that commercial lime , that applying in the traditional method, resulted in the most pronounced increase in ash content . Abdel Aal and Attia , (1993) reported that ash content increased by 15.2 % of the total ash on applying commercial lime after parching chickpea . Notwithstanding , the ash content of $NaHCO_3$, $NaCO_3$ or NaOH treated chickpea showed significantly the lowest figures comparing with lime treated one (Table 2) . This may be due to impurities in commercial lime (Abdel Aal and Attia , 1993) and / or the presence of divalent cation Ca^{+2} .

Using and increasing the concentration of commercial lime as well as NaOH in parching chickpea significantly decreased the crude fibre content comparing with the other treatments . However , the market samples showed the lowest crude fibre content (Table 2). It is known that the fibre of chickpea , as other legumes , concentrated mainly in the hulls which contact directly with the alkaline solution on soaking. So , the reduction may be due to alkaline solubilization of a part of fibres. It was very important to minimize the reduction of fibres during parching from the nutritional point of view .

As calculated by difference , the N- free extract considered the main energy component in chickpea. However, the N- free extract ranged between 62.01 and 64.19 %. Parching process appearantly didn't affect the N-free extract due to changes in other constituents (Table 2).

The concentration of lead (Pb) varied significantly between different chickpea samples (Table 3). The significant and pronounced effect was for commercial lime treatments. A marked increase was observed in Pb concentration when chickpea treated with commercial lime . The final concentration of such element was significantly correlated with the concentration of lime in soaking medium (r = 0.892**) . It was reported that commercial lime used in parching chickpea contains up to 73.3 µg Pb /g (Abdel – Aal and Attia , 1993). However , it was clear that Pb contents in both marked samples along with commercial lime treated samples are over the permissible limit of lead . Egan *et al* (1981) mentioned that maximum permissible limit of lead is 1 µg/g with specific limit of 0.2 µg/g for infants . Notwithstanding , chickpea treated with $NaHCO_3$ resulted in a product has Pb concentration still under the recommended limit (Table 3).

Data for concentrations of Co & Cd in chickpea samples understudy along with the market three samples are presented in Table 3 . It was clear that the concentrations of such elements varied significantly as a result of applying different parching treatments understudy . The point of interest was that although such treatments specially commercial lime increased markedly both two elements, the concentration of cobalt and cadmium in parched chickpea samples still under the recommended limits . However , commercial lime resulted in the highest level of Co & Cd (Table 3) .

Table 3 : Some heavy metals (µg/g,dwb) in raw and different parched chickpea samples* .

Treatment		Pb	Co	Cd
Raw		$0.75{\pm}0.03^{l}$	$0.55{\pm}0.03^{f}$	$0.084{\pm}0.005^{g}$
Without soaking		$0.80{\pm}0.02^{kl}$	$0.49{\pm}0.01^{h}$	$0.090{\pm}0.003^{fg}$
Dist H_2O		$0.78{\pm}0.04^{k}$	$0.40{\pm}0.03^{i}$	$0.082{\pm}0.003^{g}$
$NaHCO_3$	5 %	$0.90{\pm}0.05^{hi}$	$0.47{\pm}0.03^{h}$	$0.100{\pm}0.004^{ef}$
	10 %	$0.83{\pm}0.02^{jk}$	$0.43{\pm}0.03^{i}$	$0.104{\pm}0.008^{ef}$
	15 %	$0.88{\pm}0.04^{ij}$	$0.50{\pm}0.02^{gh}$	$0.102{\pm}0.005^{ef}$
Na_2CO_3	5 %	$0.95{\pm}0.04^{gh}$	$0.53{\pm}0.02^{fg}$	$0.105{\pm}0.007^{ef}$
	10 %	$1.00{\pm}0.04^{g}$	$0.46{\pm}0.04^{h}$	$0.110{\pm}0.010^{de}$
	15 %	$1.00{\pm}0.03^{g}$	$0.55{\pm}0.02^{f}$	$0.104{\pm}0.008^{ef}$
NaOH	5 %	$1.10{\pm}0.05^{ef}$	$0.56{\pm}0.03^{f}$	$0.103{\pm}0.010^{ef}$
	10 %	$1.07{\pm}0.02^{f}$	$0.65{\pm}0.03^{e}$	$0.121{\pm}0.008^{cd}$
	15 %	$1.15{\pm}0.05^{de}$	$0.62{\pm}0.03^{e}$	$0.112{\pm}0.010^{de}$
Comm. lime	5%	$1.20{\pm}0.03^{d}$	$0.66{\pm}0.05^{de}$	$0.136{\pm}0.011^{bc}$
	10%	$1.38{\pm}0.03^{c}$	$0.70{\pm}0.04^{cd}$	$0.132{\pm}0.009^{bc}$
	15%	$1.45{\pm}0.05^{ab}$	$0.78{\pm}0.04^{b}$	$0.141{\pm}0.015^{ab}$
Market sample	A	$1.52{\pm}0.05^{a}$	$0.80{\pm}0.03^{b}$	$0.150{\pm}0.007^{a}$
	B	$1.40{\pm}0.05^{bc}$	$0.71{\pm}0.05^{c}$	$0.122{\pm}0.008^{cd}$
	C	$1.47{\pm}0.04^{a}$	$0.86{\pm}0.03^{a}$	$0.151{\pm}0.010^{a}$

*** Means ± SD in a column not sharing the same superscript are significantly different at $P \leq 0.05$.**

Data for antinutritional factors in different parched chickpea samples understudy are presented in Table 4 . As would be expected , parching process resulted in a noticeable decline in trypsin inhibitor activity , phytic acid , tannins content . The degree of reduction varied significantly between treatments within the same antinutritional factors . Another considerations were :

1- The same effect of $NaHCO_3$ and commercial lime in reduction of trypsin inhibitor activity suggesting the heating process as the main cause of such reduction rather than the pH of soaking medium . Soni *et al* (1978) mentioned that roasting of seeds at 200 ^{o}C for 2 min. has been found to be the most effective dry heat treatment for destruction the anti-tryptic activity of all pulses .

2 – The superiority of $NaHCO_3$ and Na_2CO_3 in lowering phytic acid content .

3 – A positive correlation was observed between the concentration of $NaHCO_3$ or Na_2CO_3 and the % reduction of phytic acid content , while it was negative between the concentration of NaOH or commercial lime and the % reduction of phytic acid content . It seemed to be this finding

associated with the pH of soaking medium . At higher pH , both protein and phytic acid are negatively charged , thus the interaction is mediated by multivalent cations to form a ternary protein – mineral – phytate complex (Cheryan , 1980) , the finding which led to suggest the low leaching out and thus a significant high phytic acid content of parched chickpea samples treated with NaOH and lime in comparison to $NaHCO_3$ and Na_2CO_3 treated samples .

4 – NaOH and $NaHCO_3$ were more effective in reducing tannins than the other treatments . However, the net value of tannins depends on the two opposite processes i.e. leaching out and penetration from the hulls into cotyledons through soaking . It has been reported that tannins form hydrogen bound complexes with carbohydrates and proteins depending on the types and concentration of tannins , and the pH of medium (Mc Leod , 1974) .

Table 4: Trypsin inhibitor activity (TIA), phytic acid and tannins contents of raw and different parched chickpea samples* .

Treatment		TIA		Phytic acid		Tannins	
		Unit /g (DWB)	Red. (%)	mg/100g (DWB)	Red. (%)	% (WB)	Red. (%)
Raw		14.3 ± 0.10^{a}	-	534 ± 11^{a}	-	0.158 ± 0.006^{ab}	-
Without soaking		9.5 ± 0.07^{b}	33.6	487 ± 14^{c}	8.8	0.163 ± 0.002^{ab}	-3.2
Dist H_2O		9.2 ± 0.03^{b}	35.6	459 ± 10^{d}	14.0	0.137 ± 0.003^{c}	13.2
$NaHCO_3$	5%	6.1 ± 0.06^{e}	56.3	430 ± 12^{e}	19.5	0.138 ± 0.004^{c}	12.6
	10%	5.3 ± 0.10^{f}	62.9	415 ± 10^{fg}	22.3	0.123 ± 0.002^{gh}	22.1
	15%	4.2 ± 0.03^{h}	69.9	410 ± 15^{g}	23.2	0.109 ± 0.005^{j}	31.1
Na_2CO_3	5%	6.9 ± 0.02^{d}	53.8	438 ± 14^{e}	18.0	0.146 ± 0.003^{b}	7.6
	10%	6.0 ± 0.06^{e}	58.0	425 ± 13^{f}	20.4	0.132 ± 0.005^{de}	16.4
	15%	4.9 ± 0.03^{g}	65.7	420 ± 11^{fg}	21.3	0.121 ± 0.005^{hi}	23.4
NaOH	5%	8.0 ± 0.07^{c}	44.1	489 ± 10^{bc}	8.4	0.127 ± 0.003^{ef}	19.6
	10%	6.8 ± 0.07^{d}	52.4	500 ± 16^{b}	6.4	0.118 ± 0.004^{i}	25.3
	15%	5.9 ± 0.05^{e}	58.7	492 ± 10^{bc}	7.9	0.106 ± 0.002^{j}	32.9
Comm. lime	5%	5.9 ± 0.01^{e}	58.7	470 ± 15^{d}	12.0	0.135 ± 0.004^{cd}	14.5
	10%	5.1 ± 0.03^{fg}	64.3	483 ± 12^{c}	9.6	0.142 ± 0.007^{b}	10.2
	15%	4.0 ± 0.02^{h}	62.0	499 ± 14^{b}	6.6	0.133 ± 0.003^{de}	15.8
Market sample	A	5.7 ± 0.02^{e}	-	488 ± 13^{c}	-	0.172 ± 0.005^{a}	-
	B	8.3 ± 0.05^{c}	-	461 ± 11^{d}	-	0.155 ± 0.007^{b}	-
	C	6.9 ± 0.06^{d}	-	515 ± 15^{ab}	-	0.128 ± 0.004^{ef}	-

*** Means ± SD in a column not sharing the same superscript are significantly different at P ≤ 0.05 .**

Conclusion

From the food safety and nutritional point of view , it can be concluded that parching of chickpea should be carried out using another procedure rather than the traditional method that is commonly applied by parching processors in Egypt . Data shown here confirm $NaHCO_3$ (up to 15 %) as a safe substitute for parching chickpea since it produces a golden yellow acceptable product , close to the commercial one , with a low heavy metals as well as antinutritional factors in compared with the commercial lime .

REFERENCES

Abdel-Aal, E-S. S. M. and Attia, R. S. (1993). Effect of commercial parching process on the composition and heavy metals of chickpea. Alex. J. Agric. Res. 38 : 277 – 287 .

AOAC. (1995). Official Methods of Analysis. Association of Official Analytical Chemists., Washington, D C, USA.

Attia, R. S. (1992). Effect of Ripening, Dehulling, Cooking and Parching on the Chemical Composition and Nutritional Value of Chickpeas (*Cicer arietinum L*.). Ph. D. thesis, Faculty of Agriculture, Alexandria University, Egypt.

Brooks, J. R. and Morr, C. V. (1984). Phosphorus and phytate content of soybean protein components. J. Agric. Food chem.. 32 : 672-674.

Cheryan, M., Anderson, F. W. and Grynspan, F. (1993). Magnesium- phytate complexes: Effect of pH Molar ratio on solubility characteristics. Cereal Chem.. 60 : 235 – 237 .

Egan, H., Kirk, R. S. and Sawyer, R. (1981). Pearson's Chemical Analysis of Food. Churchill Livingstone , Edinburgh, PP 119-122, 126.

Kamel, A. R. M. (1984). Chemical and Technological Studies on Chickpea Seeds. M. Sc. Thesis , Faculty of Agriculture, Alexandria University, Egypt .

Khokhar, S. and Chauhan, B. M. (1986). Antinutritional factor in moth bean (*Vigna aconitifolia*) : Varietal differences and effects of methods of domestic processing and cooking. J. Food Sci., 51: 591 – 594 .

Liener, I. E. (1989). Antinutritional factors. In Legumes. Chemistry Technology, and Human Nutrition . Ed. by R. M. Matthews. Marcel Dekker, Inc.

Mc Leod, M. N. (1974). Plant tannins- their role in forage quality. Nut. Abst. Rev. , 44 : 803-815.

Moskowitz, H. A. (1974). Sensory evaluation by magnitude estimation. J. Food Technol. , 28: 16 – 22 .

Petterson, D. S.; Mackintosh, J. B. and Sipsas, S. (1997) . The chemical composition and nutritive value of Australian pulses . Grains Research and Development Corporation, Barton, ACT

Robinson, D. and Singh, D. N. (2001). Alternative Protein Sources for Laying Hens . The Rural Industries Research and Development Corporation . RIRDC Pub. Kingston Act .

Roy, D. W. and Roa, S. P. (1971). Evidence , isolation , purification and some properties of a trypsin inhibitor in *Lathyrus sativus*. J. Agric. Food Chem., 19 : 257 - 259 .

Singh, U. and Jambunathan, R. (1981). Studies on desi and kabuli chickpea (*Cicer arietinum* L.) cultivars: The levels of protease inhibitors , levels of polyphenolic compounds and *in vitro* protein digestibility. J. Food. Sci. , 46 : 1364 – 1367 .

Soni, G. L. ; Singh, T. P. and Singh, P. (1978). Comparative studies on the effects of certain treatments on the antitryptic activity of the common Indian pulses. The Ind. J. Nutr. Dietet. , 15 : 341 – 345 .

Steel, R. G. D. and Torrie, T. H. (1980) . Principles Procedures of Statistics. McGraw-Hill, Co. 82) . Phytic acid determination in soy beans. J. Food Sci. , 47 : 513 – 517.

Thompson, D. B. and Erdman, J. W. JR. (1982) . Phytic acid determination in soy beans. J. Food Sci. , 47 : 513 – 517 .

Ziena, H. M. S., Youssef, M. M. and Aman, M. E. (1997). Quality attributes of black olives as affected by different darkening methods. Food Chemistry , 60 : 501 – 508 .

تـأثير وسـط النقـع علـى الخـواص العضـوية الحسـية و التركيـب الكيمـاوى وبعـض مانعات التغذية فى الحمص المحمص

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من أجل أيجاد طريقة آمنة لتحميص الحمص تم أستخدام أوساط نقع مختلفة أشتملت على كل من بيكربونات الصوديوم ، كربونات الصوديوم ، هيدروكسيد الصوديوم ، الجير المستخدم على النطاق التجارى للمقارنة . وقد أستخدمت ثلاثة تركيزات من كل ، وهى ٥% ، ١٠% ، ١٥% حيث أجري نقع البذور لمدة ١٥ ق على درجة حرارة الغرفة وتبع ذلك التصفية والتجفيف لمدة ٢٤ ساعة على درجة حرارة الغرفة ثم التحميص على .لمدة دقيقة واحدة م240 º

هذا وقد أجرى على الحمص المحمص الناتج من جميع المعاملات الى جانب ثلاث عينات من السوق التقديرات التالية : الخواص العضوية الحسية – التركيب الكيماوى التقريبى – بعض المعادن الثقيلة (الرصاص ، الكوبلت ، الكادميوم) – مانعات التغذية (مضاد التربسين ، حمض الفايتك ، التانينات) .

وبوجة عام فأن جميع النتائج المتحصل عليها قد أختلفت معنويا فيما بين المعاملات حيث كان من ابرزها أرتفاع عينات السوق وتلك المعملية المعاملة بالجير التجارى فى كل من % للرماد والمعادن الثقيلة المختبرة وخاصة الرصاص الذى تعدى تركيزه الحدود المسموح بها تغذويا الى جانب ارتفاع مانعات التغذية وخاصة حمض الفايتك .

هذا وقد خلصت النتائج الى ان أستخدام بيكربونات الصوديوم (وحتى تركيز ١٥%) بديلا عن أستخدام الجير التجارى قد أعطى ناتجا مماثلا من حيث الخواص العضوية الحسية والأفضل من الوجهة التغذوية والآمنة .