

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°C 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 °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 (NaHCO₃), sodium carbonate (Na₂CO₃) 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.

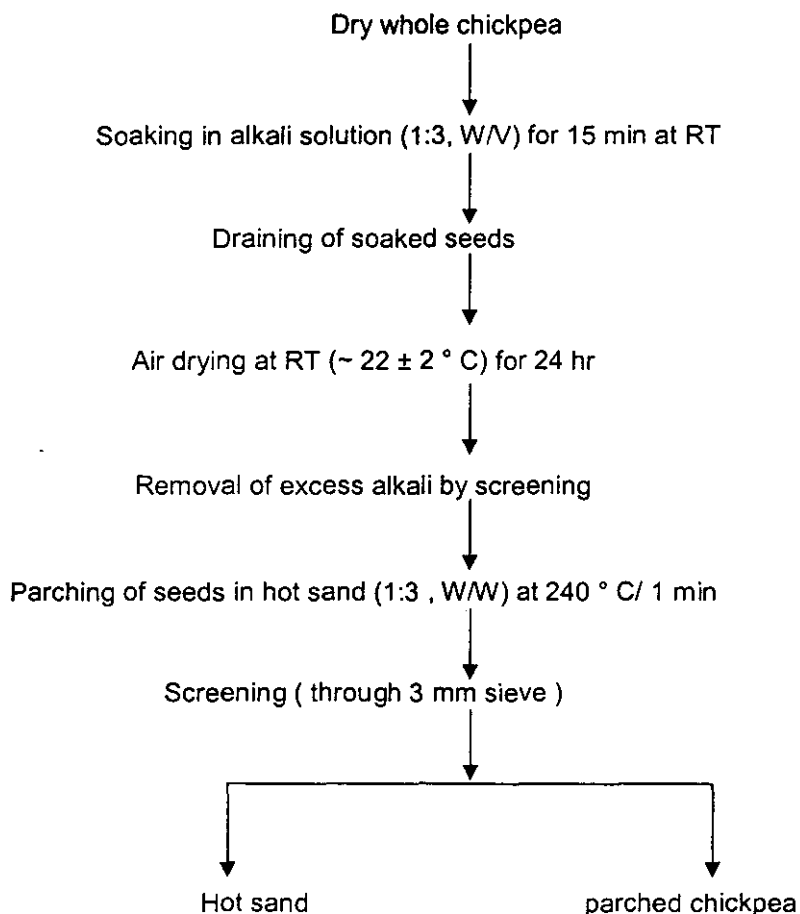


Fig. 1 : Flow sheet for preparing parched chickpea .

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 ₂ CO ₃	5%	8.30
7	Na ₂ CO ₃	10%	8.58
8	Na ₂ CO 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 spectrophotometrically (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 Ultraspec 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 samples 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% NaHCO₃ 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 NaHCO₃ 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 ^g	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 ₂ CO 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 ^g
NaOH 5%	4.8±0.4 ^h	5.2±0.3 ^h	5.5±0.4 ^{fg}	4.9±0.3 ^g
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 ^b	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 Na₂CO₃ in accordance to data published by Kamel (1984). The degree of reduction was correlated with the increment of alkali level mainly commercial lime and NaHCO₃ 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 NaHCO₃ and Na₂CO₃. 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 ^f	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 ₂ CO 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 ^g	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 ^g	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 ^g	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 ≤ 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 apparently 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 $73.3 \mu\text{g Pb /g}$ (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 $1 \mu\text{g/g}$ with specific limit of $0.2 \mu\text{g/g}$ 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 ($\mu\text{g/g,dwb}$) in raw and different parched chickpea samples* .

Treatment		Pb	Co	Cd
Raw		0.75±0.03 ^l	0.55±0.03 ^f	0.084±0.005 ^g
Without soaking		0.80±0.02 ^{kl}	0.49±0.01 ^h	0.090±0.003 ^{fg}
Dist H ₂ O		0.78±0.04 ^k	0.40±0.03 ⁱ	0.082±0.003 ^g
NaHCO ₃	5 %	0.90±0.05 ^{hi}	0.47±0.03 ^h	0.100±0.004 ^{ef}
	10 %	0.83±0.02 ^{ik}	0.43±0.03 ⁱ	0.104±0.008 ^{ef}
	15 %	0.88±0.04 ^{ij}	0.50±0.02 ^{gh}	0.102±0.005 ^{ef}
Na ₂ CO ₃	5 %	0.95±0.04 ^{gh}	0.53±0.02 ^{fg}	0.105±0.007 ^{ef}
	10 %	1.00±0.04 ^g	0.46±0.04 ^h	0.110±0.010 ^{de}
	15 %	1.00±0.03 ^g	0.55±0.02 ^f	0.104±0.008 ^{ef}
NaOH	5 %	1.10±0.05 ^{ef}	0.56±0.03 ^f	0.103±0.010 ^{ef}
	10 %	1.07±0.02 ^f	0.65±0.03 ^e	0.121±0.008 ^{cd}
	15 %	1.15±0.05 ^{de}	0.62±0.03 ^e	0.112±0.010 ^{de}
Comm. lime	5%	1.20±0.03 ^d	0.66±0.05 ^{de}	0.136±0.011 ^{bc}
	10%	1.38±0.03 ^c	0.70±0.04 ^{cd}	0.132±0.009 ^{bc}
	15%	1.45±0.05 ^{ab}	0.78±0.04 ^b	0.141±0.015 ^{ab}
Market sample	A	1.52±0.05 ^a	0.80±0.03 ^b	0.150±0.007 ^a
	B	1.40±0.05 ^{bc}	0.71±0.05 ^c	0.122±0.008 ^{cd}
	C	1.47±0.04 ^a	0.86±0.03 ^a	0.151±0.010 ^a

* Means \pm 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 NaHCO₃ 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 °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 NaHCO₃ and Na₂CO₃ in lowering phytic acid content .
- 3 – A positive correlation was observed between the concentration of NaHCO₃ or Na₂CO₃ 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 NaHCO₃ and Na₂CO₃ treated samples .

4 – NaOH and NaHCO₃ 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 (McLeod , 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 ₂ O	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 ^g	22.3	0.123±0.002 ^{ah}	22.1
	15%	4.2±0.03 ^h	69.9	410±15 ^g	23.2	0.109±0.005 ^j	31.1
Na ₂ CO 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 ^g	21.3	0.121±0.005 ^h	23.4
NaOH	5%	8.0±0.07 ^c	44.1	489±10 ^{bc}	8.4	0.127±0.003 ^{af}	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 ^g	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

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تأثير وسط النقع على الخواص العضوية الحسية و التركيب الكيماوى وبعض
مانعات التغذية فى الحمص المحمص
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من أجل إيجاد طريقة آمنة لتحميم الحمص تم استخدام أوساط نقع مختلفة أشتملت على كل من بيكربونات الصوديوم ، كربونات الصوديوم ، هيدروكسيد الصوديوم ، الجير المستخدم على النطاق التجارى للمقارنة . وقد استخدمت 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 التحميم على لمدة دقيقة واحدة م 240 ° هذا وقد أجرى على الحمص المحمص الناتج من جميع المعاملات الى جانب ثلاث عينات من السوق التقديرات التالية : الخواص العضوية الحسية - التركيب الكيماوى التقريبي - بعض المعادن الثقيلة (الرصاص ، الكوبلت ، الكاديوم) - مانعات التغذية (مضاد الترسين ، حمض الفايك ، التانينات) . وبوجه عام فإن جميع النتائج المتحصل عليها قد أختلفت معنويا فيما بين المعاملات حيث كان من أبرزها ارتفاع عينات السوق وتلك المعملية المعاملة بالجير التجارى فى كل من % للرماد والمعادن الثقيلة المختبرة وخاصة للرصاص الذى تعدى تركيزه الحدود المسموح بها تغذويا الى جانب ارتفاع مانعات التغذية وخاصة حمض الفايك . هذا وقد خلصت النتائج الى ان استخدام بيكربونات للصوديوم (وحتى تركيز ١٥%) بديلا عن استخدام الجير التجارى قد أعطى ناتجا مماثلا من حيث الخواص العضوية الحسية والأفضل من الوجهة التغذوية والأمنة .