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Influence of soaking and germination on physico-chemical composition and functional properties of chickpea (*var. SKUAST-233)* flour

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Abstract
Present study was conducted to investigate the effect of soaking and germination on physicochemical composition and functional properties of chickpea flour. Chickpea seeds were soaked in 1% $NaHCO_3$ solution for 16 hrs and germinated for 3 days in dark after soaking in distilled water for 12 hrs. Native chickpea flour was used as control. Physicochemical composition and functional properties were determined by using standard methods and analytical procedures. Soaking and germination had a significant ($p \leq 0.05$) effect on physicochemical composition and functional properties of chickpea flours. Decrease in fat, protein, ash, fibre, mineral content and increase in carbohydrate content of soaked chickpea flour was recorded while as decrease in carbohydrate, fat and an increase in protein, ash, fiber content was observed in germinated chickpea flour. There was a significant difference ($p \leq 0.05$) among the samples in water absorption capacity and oil absorption capacity with the native chickpea flour having the least value of WAC 1.60 g/g and germinated flour having highest OAC of 1.36 g/g, respectively. Significant ($p \leq 0.05$) differences in WAI, WSI, FC, FS, EC and ES was observed with soaked sample having lowest WAI (2.63 g/g), FC (36.70%), FS (63.90%), EC (63.92%), ES(65.30%) and highest WSI (20.51%), respectively. Bulk density of all samples ranged from 0.62- 0.67 g/ml.

Keywords: chickpea flour, Soaking, germination, functional properties, composition, etc.

1. Introduction
Legumes, such as beans and chickpea are one of the most important crops in the world because of their nutritional quality (Arab *et al*., 2010) [9]. Legumes are known as "a poor man's meat" because they are a valuable sources of proteins, carbohydrates, non-starch polysaccharides (dietary fibre) and a small but significant amount of oligosaccharides (Hemeda and Mohamed, 2010) as well as vitamins and minerals (B-vitamins, folates, and iron), antioxidants and polyphenols (Han *et al*., 2010) [19]. Among the different legumes, chickpea (*Cicer arietinum L*.) is one of the oldest and most widely consumed legumes in the world and it is a staple food crop particularly in tropical and subtropical areas (Alajaji and El-Adawy, 2006; Nwokolo and Smartt, 1996) [3, 31]. The use of chickpea grains for human food has long history and used in different forms as green vegetable (green immature seed), 'Kollo' (soaked and roasted), 'nifro' (boiled seeds) and 'wot' (sauces) made up of 'shiro' (powdered seeds) or blended with cereals and/or legumes for preparing of infant and young children foods using traditional food processing techniques like soaking, germination, fermentation, boiling, roasting etc. The chickpea contains high levels of carbohydrate (41.10-47.42%) and protein (21.70-23.40%). It has a high protein digestibility and is rich in vitamins and minerals (Muzquiz and Wood, 2007). Iron is the most abundant mineral present in chickpea (4.6 to 10.5%) followed by zinc (2.2-6.8%). Chickpea seeds also contain some antinutritional factors. The presence of antinutritional factors such as tannins, phytates, trypsin inhibitors and heamagglutinins restricts its use by interfering with digestion of carbohydrates and proteins (Arab *et al.*, 2010) [9].

Soaking is an integral part of various bean processing methods including germination. It is the first step in most methods of legume preparations. It decreases toxin and surface contamination. Soaking offers dual advantage of saving energy cost by reducing cooking time as well as rendering the legumes nutritionally superior by removing antinutritional factors. Germination is one of the most common processes for improving the nutritional quality of pulses, not only by the reduction of anti-nutritive compounds, can also increase protein

content, dietary fiber, vitamin and bioavailability of trace elements and minerals (Kaushik *et al*., 2010) [23]. Therefore, the objective of this study was to assess the effect of soaking and germination on physicochemical composition and functional properties of chickpea flours.

2. Material and methods

Sample Collection and Preparation

Chickpea *(var. SKUAST-233)* was procured from SKUAST-K Shalimar. Seeds were hand sorted to remove immature seeds, stones and other unwanted materials.

Soaking

200 g of chickpeas were soaked in 1000 ml of sodium carbonate solution (1% w/v) at room temperature for 16 h. The soaked cotyledons were separated from the soaking solution, washed thoroughly with water and then air-dried at room temperature (Marquez and Alonso, 1999) [25].

Germination

Chickpea seeds were sterilized by soaking in ethanol for 1 min. The seeds were soaked in distilled water (1:10, w/ v) for 12 h at room temperature (25 °C), then kept between thick layers of cotton cloth and allowed to germinate in the dark for three days. The germinated legume were washed thoroughly and then air dried at room temperature (Mugendi *et al*., 2010) [27].

The three chickpea samples (control, soaked and germinated) were milled separately and packed in polyethylene bags for further analysis.

Methods of analysis

Effect of soaking and germination on Physico-chemical composition of chickpea flour

Moisture (%)

Moisture content was determined by AOAC method 930.04 (AOAC, 1995) [6]. 5 g of sample was weighed and dried at 60-70 ºC for 6-8 hours, to constant weight. The loss in weight was determined to calculate the percent moisture content.

Crude protein (%)

Crude nitrogen was determined by Kjeldahl method (Elinge *et al*., 2012) [16] and crude protein was then determined by using the equation (3.2) (AOAC, 1995) [6].

Crude protein = Crude nitrogen × 6.25 **(1)**

Crude fiber (%)

Crude fiber was determined by following a gravimetric procedure of AOAC (AOAC, 1995) [6].

Ash (%)

Ash content was determined by incineration at 550ºC in a muffle furnace for 6 hours (AOAC, 1995; Elinge *et al*., 2012) [16, 6].

Crude fat (%)

Crude fat was determined using BIOSOX using petroleum ether as a solvent (Amin and Thakur, 2014) [5].

Carbohydrate (%)

Carbohydrate (CHO) content was determined by using an equation (2) as given below:

CHO (%) = 100 – (%moisture + %ash + %crude protein + %crude lipid + %fiber) **(2)**

Dietary fiber (%)

Dietary fiber was estimated by dietary fibre analyzer (FIBRAPLUS DF) using the method as given by AOAC (1985) [7]. A known quantity of sample was incorporated in four 500 mL beakers in equal amount. 50 mL of 0.08 M phosphate buffer (pH-6) was added to each beaker with 0.1 mL α-amylase. Beakers were covered with aluminum foil and placed in shaking water bath for 15 min at 95 °C followed by cooling the beakers to room temperature. 10 mL of 0.275 N NaOH solutions was added to the beakers to adjust the pH to 7.5. 5 mg of protease was added to each beaker and 0.1 mL of 0.08 M phosphate buffer was added to adjust the pH to 6. Again the beakers were incubated in shaking water bath for 30 min at 60 °C. After cooling, 10 mL of 0.325 N hydrochloric acid solution was added to maintain the pH to 4.5. 0.3 mL of amyloglucosidase was added to each beaker and incubated for 30 min at 60 °C. Solution obtained was filtered through glass crucibles. Precipitate was transferred from enzymatic digest to crucibles and washed with 20 mL of 78% ethanol and 10 mL of 95% ethanol and finally with 10 mL of acetone. Crucibles containing residue were dried in hot air oven and cooled. Crucibles were weighed to determine the weight of insoluble dietary fiber (IDF) residue calculated using an equation (3.4). Duplicate residue was analyzed for protein by micro- Kjeldahl Method. Another residue was incinerated for ash. The left over filtrate, four volumes of 95% ethanol were added to precipitate soluble dietary fiber (SDF). SDF was calculated using an equation (3.5). After one hour, the precipitate was transferred into crucibles, fitted in filtration module and the above procedure of estimating protein in sample residue and ash content in duplicate sample residue was repeated to get SDF value. Total dietary fiber (TDF) was determined as the sum of IDF and SDF as given in equation (3.6);

Calculations

$$\textbf{Blank}\ (\%) = \textbf{Weightof blank residue} - (\textbf{protein in blank residue} + \textbf{ash in blank residue}) \times \textbf{100} \quad \textbf{(3.4)}$$

$$\textbf{IDF}\ (\%) = \frac{[(\textbf{Weight of IDF residue}) - (\textbf{protein in IDF residue} + \textbf{ash in IDF residue}) - \textbf{blank}]}{\textbf{Weight of sample (g)}} \times \textbf{100} \quad \textbf{(4)}$$

$$\textbf{SDF}\ (\%) = \frac{[(\textbf{Weight of SDF residue}) - (\textbf{protein in SDF residue} + \textbf{ash in SDF residue}) - \textbf{blank}]}{\textbf{Weight of sample (g)}} \times \textbf{100} \quad \textbf{(5)}$$

$$\boldsymbol{TDF} = (\boldsymbol{IDF} + \boldsymbol{SDF})$$

Mineral Analysis

Mineral analysis of samples was carried out by following the procedures as described in AOAC method No. 3.014-016 (AOAC, 2003) [8] using Inductive Coupled Plasma-Atomic Emission Spectra (ICP-AES).

Functional properties of raw and extruded chickpea flours

Bulk density

The procedure of Akpapunam and Markakis (1981) was used to determine the bulk density of the flour. A known weight of the flour was taken into a preweighed (W_1) measuring cylinder and the weight of the cylinder (W_2) as well as the volume of the flour (V_1) was noted. The bulk density (BD) was expressed using an equation (3.7).

$$BD = W_2 - W_1 \div V_1 \quad \textbf{(6)}$$

Colour
Colour of the starch was determined using colour flex Spectro colorimeter (Hunter lab colorimeter D-25, Hunter Associates Laboratory, Ruston USA) after being standardized using Hunter lab colour standards and their Hunter *L* (lightness), *a* (redness to greenness) and *b* (yellowness to blueness) values were measured.

Water absorption capacity (WAC) (%)
The water absorption capacity (WAC) of the legume flours was measured using the centrifugation method reported by Kaur and Singh (2006) [22]. Each sample (3.0 g) was dissolved in 25 mL of distilled water and placed in a 50 mL preweighed centrifuge tube. The mixture was stirred at 5 min intervals and held for 30 min, followed by centrifugation for 30 min at 3,000×*g*. The supernatant was decanted and the excess moisture was removed at 50 °C for 25 min and the sample was reweighed.

$$WAC = 100 \times (W_2 - W_1 \div W_0) \quad (7)$$

Where, W_0 is the weight of the sample, W_1 is the weight of centrifuge tube plus sample and W_2 is the weight of centrifuge tube plus the sediments.

Oil absorption capacity (OAC)
The water absorption index (WAI) and water solubility index (WSI) of the flours was determined by method of Muzaffer *et al*. (2016). 2.5 of flour was mixed with 20 ml mustard oil and then stirred for 30 min at 25 ºC. The slurry was then centrifuged at 3000 × *g* for 10 min (5810R, Eppendorf, Hamburg, Germany) and the supernatant was decanted. Gain in weight was expressed as percentage of oil absorption capacity.

Water absorption index (WAI) and water solubility index (WSI)
The water absorption index (WAI) and water solubility index (WSI) of the legume flours were determined by referring to the methods reported by Kaur and Singh (2006) [22]. A legume flour sample (3 g) was dissolved in 30 mL distilled water and heated in a water bath at 90 °C for 15 min. Then, the cooked paste was cooled to room temperature, transferred to pre-weighed centrifuge tubes, and centrifuged at 3,000×*g* for 10 min. The supernatant was decanted into a pre-weighed evaporating dish to determine its solid content and the sediment was weighed. The weight of dry solids was recovered by evaporating the supernatant overnight at 105 °C. The WAI and WSI were calculated using Equations 8 and 9

$$WAI\ (g/g) = (\text{weight of sediment}) / (\text{Weight of flour sample (g)}) \quad (8)$$

$$WSI\ (\%) = (\text{weight of dissolved solids in supernatant}) / (\text{Weight of flour sample (g)}) \times 100 \quad (9)$$

Gelation properties (least gelation concentration)
The gelation properties of the flour were determined by the method described by r A series of sample suspensions of increasing concentrations *i.e.* 2, 4, 6, 8, 10, 12, 14, 16, 18 and 20% (m/v) were prepared in distilled water (10 mL). All the suspensions were heated gently for 1 hour in a boiling water bath. The heated suspensions were cooled at 4 °C for 2 hours and then inverted one after the other. The least gelation capacity (LGC) was taken as the concentration at which the inverted suspension did not fall or slip.

Foaming capacity
Foaming capacity (FC) of the flour was determined by the known method (Coffman and Garcia, 1977) [12]. The flour (2 g) was dispersed in distilled water (100 mL) and homogenized properly for two minutes in a kitchen blender. The volumes were recorded before and after homogenization and percent increase in the volume was calculated as FC of the flour by using the equation (10).

$$FC\ (\%) = V_2 - V_1 \div V_1 \quad (10)$$

Where, V1 = initial volume; V2 = volume of solution after homogenization.

Foaming stability
The foam was allowed to stand for 8 hours at room temperature and the foam stability (FS) was expressed as the percentage retention of the of initial foam volume as expressed in equation (11).

$$FS\ (\%) = 100\ (V_t \div V_0) \quad (11)$$

Where, V0 = initial foam volume and Vt = foam volume after time (t).

Emulsifying activity and Emulsifying stability
Emulsifying activity (EA) and emulsion stability (ES) were determined by following the method of Neto *et al*. (2001) [30]. The flour (2 g) was dispersed in distilled water (100 mL) and height of solution in the cylinder was measured. After standing for 2 minutes, the solution was homogenized with refined coconut oil (5 mL). The resulting emulsion was centrifuged (1100 × g) for 5 minutes. The height of the emulsified layer was measured and the emulsifying activity was calculated using equation 12

$$EA\ (\%) = 100\ (H_2 - H_1 \div H_1) \quad (12)$$

Where, H_1 is the initial height of unemulsified solution while H_2 is height of emulsion.
This was then followed by centrifugation at 1100 × g for 5 minutes. The emulsion stability was determined by the following equation 13

$$ES\ (\%) = 100\ (H_t \div H_2) \quad (13)$$

Where, H_2 is the height of the emulsified layer before heating while Ht is the height of the emulsified layer after heating.

3. Result and discussion
Physicochemical composition
Moisture
Effect of soaking and germination on physico-chemical composition of chickpea flour is presented in Table 1. Moisture content of raw, soaked and germinated chickpea flour was 10.15 %, 10.50 % and 10.67 %. Soaking and germination caused significant increase ($P<0.05$) in the moisture content of chickpea flour which may be attributed to the water absorbed during soaking, germination and autoclaving. The results are in agreement with Mubarak (2005) [26] who also reported an increase in the moisture content of mung bean seeds during soaking and germination.

Protein
The data reveals that soaking and germination exhibited significant ($P<0.05$) influence on protein content of chickpea flour (table 1). The significant reduction in protein content of chickpea during soaking may be attributed to protein

denaturation by the heat generated or leaching of some of the water-soluble proteins into the soaking medium. Edijale (1980) [13] also reported the decrease in protein content of cowpea during soaking process and attributed this decrease to the leaching loss and solubility of nitrogen in soaking medium. The decrease in total carbohydrates during germination for energy production may be associated with an increase in crude protein. These results are in agreement with those reported by El-Beltagy (1996) [15] for germinated mung bean seeds and El-Adawy (2002) [14] for germinated chickpea.

Fat

The fat content of raw chickpea flour was 6.60 % and decreased significantly (P<0.05) by all methods of processing. The decrease in fat content during soaking of chickpeas agrees with the findings of Okigbo (1975) [33] on soybean and Albrecht *et al*. (1996) [4] on beans and has been attributed to the loss of soluble materials on soaking. Salve and Mehrajfatema (2011) [37] also reported the reduction in the fat content in soaked moth bean flour. As fat serves as store house of energy during embryo development, it also accounts for its reduced levels in germinated chickpea seeds. The results are in accordance with the reports of Alajaji and EL-Adawy (2006) [3].

Ash

Ash content of the raw chickpea flour was 3.60 % and decreased significantly (P<0.05) during soaking (3.37 %) while as ash content increased during germination (3.65%) but the increase was non-significant (table 1). Okorie *et al.* (2013) [34] reported decrease in the ash content of the soaked flour of *Egusi* (4.15% to 3.44%) and *Ogbono* flour (3.08% to 1.64%) and attributed this decrease to the leaching of minerals into the water.

Crude and dietry fibre

The crude fibre and dietry fibre content of chickpea flour is presented in table 1. Crude fibre content of flours ranged from 3.76 to 5.07 % and dietry fibre ranged from 5.57 to 7.34. Significant increase (P<0.05) in the crude fibre and dietry fibre content of chickpea seeds by germination was mainly due to the use of seed components and degradation of protein to simple peptides during the germination process.

Table 1: Effect of different processing methods on the composition of chickpea flour

TREATMENT	Moisture (%)	Crude Fat (%)	Crude Protein (%)	Crude fibre (%)	Ash (%)	Carbohydrates (%)	Dietary Fibre (%)
Control	10.15±0.01^a	6.60±0.01^a	20.18±0.010^a	3.80±0.030^a	3.60±0.10^a	55.67±0.08^a	5.57±0.012^a
Soaked chickpea flour	10.50±0.02^b	6.20±0.007^b	20.03±0.014^b	3.76±0.010^b	3.37±0.04^b	55.87±0.70^b	4.85±0.010^b
Germinated chickpea flour	10.67±0.03^c	6.34±0.015^c	24.68±0.015^c	5.07±0.019^c	3.65±0.02^c	49.58±0.02^c	7.34±0.007^c

Control: Raw chickpea flour

Values are presented as mean±standard deviation

Values with different superscripts within the column differ significantly (p≤0.05)

Carbohydrates

Carbohydrate content of chickpeas decreased significantly (P<0.05) from 55.67% to 49.58 % during germination while as effect of soaking on carbohydrate content was non-significant. The reduction in carbohydrate content may be attributed to utilization of carbohydrates as the source of energy by the developing embryo during germination (Chinma *et al*., 2009) [11]. These results are in agreement with those reported by El-Beltagy (1996) [15] for germinated mung bean seeds and El-Adawy (2002) [14] for germinated chickpea.

Minerals

Mineral content of flours is presented in table 2. Significant (P<0.05) reduction in calcium, phosphorus, iron and zinc was noted in soaked and germinated chickpea flour. This decrease in mineral content may be attributed to leaching of minerals into soaking medium (Okorie *et al*., 2013) [34].

Table 2: Effect of different processing methods on the mineral content of chickpea flour

Sample	Mineral Profile			
	Phosphorus (mg100g^{-1})	Calcium (mg100g^{-1})	Iron (mg100g^{-1})	Zinc (mg 100g^{-1})
Control	198.05±2.01	164.81±1.53	6.50±0.05	3.89±0.001
Soaked chickpea flour	153.15±1.58	128.23±1.03	5.28±0.02	2.89±0.003
Germinated chickpea flour	168.95±1.06	165.00±1.20	5.94±0.04	3.37±0.001

Control: Raw chickpea flour

Values are presented as mean±standard deviation

Values with different superscripts within the column differ significantly (p≤0.05)

Functional properties

Bulk density, Least gelation concentration (LGC) and colour

Effect of soaking and germination on Bulk density, Least gelation concentration and L, a and b values of chickpea flour is presented in table 3. Bulk density of soaked and germinated flours decreased significantly (P<0.05) from 0.67 g ml^{-1} to 0.64 g ml^{-1} and 0.62 g ml^{-1}, respectively. This decrease in bulk density has been attributed to breakdown of complex compounds into simpler ones.

Least gelation concentration increased significantly (P<0.05) in soaked and germinated flour from 6.60 % (raw chickpea flour) to 8.80 % (soaked chickpea flour) and 13.30 % (germinated chickpea flour), respectively. L value increased from 87.66 to 89.51 for germinated flour while as slight decrease was observed in L value of soaked flour (87.32) indicating that germinated chickpea flour was lighter in colour. Negative a value of raw chickpea flour indicates that the flour was greenish in colour while as a value was positive for both soaked and germinated chickpea flours. b value of raw, soaked and germinated flours was 26.33, 25.50 and 23.45, respectively.

Table 3: Effect of different processing methods on the color, bulk density and least gelation concentration (LGC) of chickpea flour.

Parameter	Colour			Bulk density (g ml^{-1})	LGC (%)
	L*	a*	b*		
Control	87.66±0.05^a	-0.86±0.01^a	30.93±0.34^a	0.67±0.001^a	7.33±0.02^a
Soaked chickpea flour	87.32±0.03^a	1.07±0.03^b	25.50±0.30^b	0.64±0.005^b	8.80±0.02^b
Germinated chickpea flour	89.51±0.07^b	0.97±0.07^c	23.45±0.54^c	0.62±0.004^c	13.20±0.01^c

Control: untreated chickpea flour
Values are presented as mean±standard deviation
Values with different superscripts within the column differ significantly (p≤0.05)

WAC and OAC

Table 4 shows significant difference (P<0.05) in WAC of soaked and germinated chickpea flours. soaking and germination increased the WAC of chickpea flour from 1.60 g/g to 1.65 g/g and 1.97 g/g, respectively. Similar results were reported by Onweluzo and Morakinyo (1996) [35] on soaked and roasted *A. Africana* flour. The increase observed in WAC may be attributed to the production of compounds having good water holding capacity such as soluble sugars (Adedeji *et al*., 2014).

Soaking decreased the OAC of chickpea flour from 1.24 to 1.19 g/g while as germination increased the OAC from 1.24 to 1.36 g/g, respectively. Changes in OAC of chickpea flour can be explained by the variations in the amounts and physical properties of the other food components such as fat and carbohydrates (Kinsella, 1976) [24]. Giani and Bekebain (1992) [18] reported that germination of grains enhances the oil absorption capacity due to the entrapment of oil related to the nonpolar side chains of proteins

WAI and WSI

There were significant differences (P<0.05) in WAI of processed chickpea flours (Table 4). Raw chickpea flour (2.71 g g^{-1} differed significantly (P<0.05) in WAI from soaked (2.63 gg^{-1}) and germinated chickpea flours (2.75 g g^{-1}). Ocheme and Chinma (2008) [32] also reported an increase in the WAI of millet flour as a result of germination. The increase may be attributed to an increase in soluble solids as a result of breakdown of lipid, fiber and larger amount of amylose–lipid complex in flour that could inhibit the swelling of starch granules.

Significant (P<0.05) increase in WSI of chickpea flour was observed after soaking (20.10 -20.51 %) while as reduction in WSI of germinated flour noted from 20.10 -18.53 %. Similar results have been reported by Borijindakul and Phimolsiripol (2013) [36] in germinated *Dolichos lablab*.

Foaming capacity and stability

Soaked (36.70% and 63.90 %) and germinated flours (48.31 % and 98.35 %) differed significantly (P<0.05) from raw chickpea flour (45.81 % and 87.3 %) in foaming capacity and stability (table 4). Decrease in foaming capacity has also been reported by Okorie *et al*. (2013) [34] for soaked Ukpo flour. Increase in foaming capacity and stability of germinated flour has been attributed to presence of surface active proteins (Eltayeb *et al*. 2011) [17] and increased protein content of geminated flours (Brou *et al*., 2013) [10].

Emulsion capacity and stability

Emulsion capacity and stability of processed chickpea flours is presented in table 4. Germination increased the emulsion capacity (66.8 – 73.36 %) but decreased stability (79.3-78.94%) of chickpea flour while as soaking decreased the emulsion capacity (66.8-63.12%) and stability (79.30-65.30) of chickpea flour. The increase observed in emulsion capacity could be due to an increase in the area of stabilized oil droplet at interface which is a function of the food components (Imtiaz *et al*., 2011) [21].

Table 4: Effect of different processing methods on the functional properties of chickpea flour

Sample	WAC (g/g)	OAC (g/g)	WAI(g/g)	WSI (%)	FC (%)	FS (%)	EC (%)	ES (%)
Control	1.60±0.38^a	1.24±0.01^a	2.71±0.002^a	20.10±0.14^a	45.81±0.24^a	87.3±0.002^a	66.8±0.02^a	79.3±0.10^a
Soaked chickpea flour	1.65±0.54^b	1.19±0.02^b	2.63±0.001^b	20.51±0.10^b	36.70±0.30^b	63.90±0.003^b	63.12±0.07^b	65.30±0.09^b
Germinated chickpea flour	1.97±0.59^c	1.36±0.14^c	2.75±0.007^c	18.53±0.10^c	48.31±0.30^c	90.45±0.004^c	73.36±0.09^c	78.94±0.05^c

WAC: water absorption capacity; OAC: oil absorption capacity; WAI: water absorption index; WSI: water solubility index; FC: foaming capacity; FS: Foaming stability; EC: emulsion capacity; ES: emulsion stability
Control: untreated chickpea flour
Values are presented as mean±standard deviation
Values with different superscripts within the column differ significantly (p≤0.05)

4. Conclusion

The results of this study indicated that soaking and germination had tremendous effect on the physicochemical composition and functional properties of chickpea flour. Both soaking and Germination have tendency to improve the nutritional value of lablab bean by reduction of antinutritional factors. Germinated samples had highest protein content and performed better in terms of water absorption capacity, oil absorption capacity, Water absorption index, foaming and emulsion capacity. Therefore, it is suggested that soaking and germination of legumes can improve their nutrient bioavailability and can be used as an appropriate technique for production of foods having better nutritional properties.

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