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Nutritional Profiles of Released and Promising Ethiopian Chickpea Varieties

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Abstract

Improvement of varieties have significantly increased production of chickpea in Ethiopia. Never the less, there is limited information on their nutritional profiles in compiled way for varieties selection. The objective of this study was to generate compiled information on nutritional profiles of one promising and twenty-one released chickpea varieties. Crude protein, moisture, ash, oil, and fiber were analyzed using kjeldhal, oven, furnace, nucleic magnetic resonance and acid-base digestion methods, respectively, while atomic absorption spectroscopy was used for minerals. Data was analyzed by one factor ANOVA using SPSS software. The proximate compositions of some chickpea varieties were statistically different ($p<0.05$). *The protein content ranged from 16.23 to 23.82. The highest Fe (4.65) and Zn (*3.86*mg/100g) contents were recorded from Akaki and Arerti, respectively. This showed that some varieties had higher protein, and minerals. It is advisable to use high protein variety (Ejeri 23.82%) for protein targeted breeding and food fortification. For Fe improvement, Akaki (4.65), Shasho (4.58), Worku (4.57) and Dubie (4.49%) could be recommended while Arerti (3.86) is the best for Zn fortification. The promising variety (Dz-2012-19) had better protein (22.60%) and Zn content (3.80mg/100g) and breeders can use this data as complementary information to yield and disease resistance for selection of this variety.*

Keywords: Chickpea varieties; crude protein; nutritional profile; proximate compositions

Introduction

Improvement of varieties have significantly increased production of chickpea in Ethiopia in recent decades and it is contributing to food and nutrition security (Mahto *et al.* 2022). Research advances in breeding and crop management practices brought this significant improvement (Asnake and Dagnachew, 2019). Ethiopia is one of the top ten chickpea-producing countries in the world and the first producer in Africa (Fikre, 2016). Chickpea is the second exported commodity next to white pea beans generating about 25% of the total legumes export earnings (Ferede *et al.* 2018). According to Ethiopia's Central Statistics Agency (2021/2022), the production in quintals of both red and white chickpea is 3,113,057.25 and 899,327.88, respectively. This amount is very high that can play a major role in prevention of malnutrition in this country.

Nutritionally, chickpea is a good source of protein, Carbohydrates and minerals, its protein quality (digestibility) is considered to be better than other pulses (Chitra *et al.* (1995). Chickpea has significant amounts of all the essential amino acids except Sulphur containing amino acids (methionine and cysteine). Starch is the main storage carbohydrate in chickpea followed by dietary fiber, oligosaccharides (Chibbar *et al.* 2010). Oils are present in low amounts where unsaturated fatty acids (linoleic and oleic acid) are predominant (Kaur, 2005). Chickpea is also a good source of an important minerals like potassium, calcium, magnesium, phosphorus (Cabrera *et al.* 2003). In addition, it is also important to maintain soil fertility by fixing atmospheric nitrogen (Agarwal *et al.* 2012).

Malnutrition affects about 170 million people especially preschool children and nursing mothers of developing countries (Iqbal *et al.* 2006). Pulses provide a major share of protein and calories in Afro-Asian diet. Among the different pulses, chickpea is reported to have higher protein bioavailability (Yust *et al.* 2003). Based on this, it can be said that chickpea is the best option to reduce malnutrition caused due to low protein consumption. It can be accessed by many population at accessible cost instead of animal source protein (which is expensive). According to Joint WHO/FAO/UNU (2007), the average protein intake recommendations for human adults (young and old) were set as 0.66 and 0.83 g/kg/day, respectively. The estimates for protein requirements in both elderly men and women were derived to be 0.9 and 1.2 g/kg/day as the EAR and RDA (Courteny *et al.* 2016). Chickpea is an ideal protein source that fits this requirements if consumed at adequate amount.

There are about 34 kabuli and desi type chickpea from regional and Ethiopia Institute of Agricultural Research centers. However, there is limited information on nutritional profiles of chickpea varieties. There was no study conducted yet that includes all productive varieties in order to have full information. Although breeders have done a lot to increase yield of chickpea to ensure food security, ensuring of nutritional security was not emphasized. Therefore, the objective of this study was to establish a baseline and a robust quality database for improved and promising Ethiopian chickpea varieties. This information will assist breeders in prioritizing nutritional quality alongside high yield during variety selection, as well as aid processors in choosing high-quality varieties.

Materials and Methods

The study Area

The experiment was conducted at Debre Zeit Agricultural Research Center (DZARC), in Food and Nutrition Research Laboratory. Debre Zeit is located 47 km in the direction of South East of Addis Ababa. The geographic location of

DZARC is 8°44’N latitude and 38°58’E longitude, with an elevation of 1860 masl. The research center receives an annual rainfall that ranges from 452.8 to 934.2 mm, with annual mean of 691.5 mm and the mean annual temperature is 19.32°C.

Sources of chickpea varieties

A total of twenty-two (21 improved and 1 promising) chickpea varieties grown on Debre Zeit black soil in 2011 E.C. rainy season were collected from Debre Zeit Pulse research program. The grain samples were cleaned, ground to 1mm mesh size and packed in airtight plastic containers and stored at 4oC for later analysis

Table 1: Improved and promising Ethiopian chickpea varieties

No	Variety Name	Type	Year of Release	No	Variety Name	Type	Year of Release
1	Akaki	Desi	1995	12	Worku	Desi	1994
2	Mariye	Desi	1985	13	Naatolii	Desi	2007
3	Tekataye	Desi	2013	14	Dubie	Desi	1978
4	Shasho	Kabuli	1999/00	15	Koka	Kabuli	2019
5	Chefe	Kabuli	2004	16	Arerti	Kabuli	1999/00
6	Hora	Kabuli	2016	17	Dalota	Desi	2013
7	Dhera	Kabuli	2016	18	Dz-10-4	Deci	1974
8	Habru	Kabuli	2004	19	Minjar	Desi	2010
9	Dz-10-11	Desi	1974	20	Acos Dubie	Kabuli	2009
10	Dimtu	Desi	2016	21	Ejeri	Kabuli	2005
11	Teji	Kabuli	2005	22	Dz-2012-19	Kabuli	Promising

Determination of Nutritional Contents

Moisture content was determined by drying of 2g of chickpea flour in an oven at 105°c overnight and the result expressed as percentage. Protein, fiber and ash were determined using the standard methods of AOAC (2016). Crude oil was analyzed by NMR (Nuclear Magnetic Resonance) while carbohydrate content was calculated using the difference method (100 - moisture content + crude protein + oil + ash + crude fiber %). The minerals Fe (Iron), Ca (Calcium) and Zn (Zinc) were evaluated using atomic absorption spectroscopy. P (Phosphorus) and Na (Sodium) were analyzed using Flame photometer. The energy content was obtained as follows: 4* Carbohydrate + 4 * Protein + 9 * crude oil %.

Statistical Analysis

The data generated in triplicate were analyzed using SPSS version 20 and results were expressed as mean ± standard deviation. The significant differences between the means were determined by one-way analysis of variance (ANOVA) using Fishers multiple range.

Results and Discussion

Nutritional Compositions

Proximate Compositions

Moisture content determination is an integral part of the proximate composition analysis of foods. It is determinant parameter in quality and storage time of any seeds. Significant ($p<0.05$) variation among the tested chickpea samples was observed for moisture content (Table 2). The highest results were recorded from Dalota (9.37%) and Chafe (9.3%) varieties while the lowest moisture content was recorded from Arerti (5.6%). Beruk (2015) reported that the moisture content of 7.69% for the kabuli type chickpea in agreement with the current study result. Similarly, Hefnawy *et al.* (2012) has reported 9.5% moisture content of chickpea.

Ash is the total mineral contents in animal and plant source foods. The ash contents of the chickpea cultivars were significantly ($p<0.05$) different. The highest mean was obtained from Dubie (5.7%, desi type) whereas the lowest mean was from Chefe variety (kabuli type). The result reported by Sharma *et al*. (2013) indicated that desi type had higher ash content (3.9 %) than kabuli (3%). The report by Nigozi *et al.* (2015) has revealed that ash content of the two chickpea types are in range of 3.05% to 10.85%. Most of the current results (1.93-5.7%) were in range of the reported results.

Crude fiber (CF) is the indigestible part of plant food (Jukanti *et al.* 2012). It is composed of poly/oligosaccharides, lignin and other plant-based substances (AACC, 2001). Dietary fibers are useful in reducing blood cholesterol (Chevan *et al.* 1986). There was significant ($p<0.05$) variation among the chickpea varieties in crude fiber (Table 2). The fiber contents of Dalota (11.22%) and Dz-10-11(10.67%) varieties were the highest while the lowest fiber content recorded from Ejeri (2.30%) variety. These results indicated that desi type (Dalota) was scored highest crude fiber content than kabuli type (Ejeri). The lower fiber content in kabuli compared to desi could be due to higher degradability of kabuli type (Sanchez-Vioque *et al.*, 1999). The result of this work is supported by Nigozi *et al*. (2015) who reported that desi-type had the highest crude fiber (11.18 %) than kabuli (7.01%). According to Rincon *et al.*, (1998) and Wood and Grusak (2007), the reason why desi have high fiber content could be due to thicker seed coat (11.5 % of total seed weight) compared to Kabuli (4.3-4.4 %). Fiber requirement is about 30g/day for adults. British Nutrition Foundation (2016) have reported the fiber requirement for adolescents (11-16 years) and adults (above 17 years) to be 25 and 30g per day, respectively. It has higher amount of dietary fiber among pulses (Jukanti *et al.* 2012). Even though the fiber of chickpea is slow digested and causes abdominal discomfort, its digestibility can be improved through germination that breakdown certain anti- nutrients and flatulence causing factors (Vasishtha and Srivastava, 2013). In general, the nutritive value and digestibility of legumes are very poor unless subjected to some pre-treatments like soaking and germination or cooking (Liener, 1976).

The production of animal protein is more expensive than plant-based protein (Chardigny and Walrand, 2016). Chickpea is an economical source of vegetable protein, which include essential amino-acids (Clement *et al.* 2000). There was significant ($p<0.05$) variation among the analyzed chickpea varieties for protein content (Table 2). The highest protein content in this study was obtained from Ejeri (23.84%) and Dz-2012-19 (22.60%) verities whereas Akaki (16.13%) have the lowest. The difference might be caused by varieties and soil nitrogen content. The crude protein content varied from 16.23 to 23.82% being higher in kabuli than in desi types. According to Sharma *et al.* (2015), higher crude protein was recorded for kabuli types. The report by Esayas *et al.* (2012) has also revealed that the protein content of Kabuli type (Habru) was higher (20.92%) than desi type (19.57%). Similarly, Nigozi *et al.* (2015) reported kabuli type with the highest (19.46%) protein content. The report for Habru variety in current result was 16.70% which is different from this previous study. In addition, Beruk (2015) has also reported that the protein content of kabuli chickpea was 21.07% whereas the current study shown the protein content to be 18.80% for same varieties. This difference may come from environmental or other factors. The protein content of chickpea is influenced by genetic and environmental factors (Owusu and Curdy, 1991).

The protein digestibility of chickpea was reported to be 89% which is lower compared to that of an egg (98%) (Hoffman and Falvo, 2004; Maringeli and Hoouse, 2007). This shows that chickpea contains a protein with low quality in comparison to animal source foods. However, cereals and legume protein can be used as a complementary since they have sulfur containing amino acids and lysine, respectively but not vice versa (Duranti, 2006). According to Chitra *et al.* (1995), in vitro protein digestibility values for chickpea was 65.3-79.4% which is higher compared to other pulses (pigeon pea 60.4 to 74.4, mung bean 67.2 to 72.2% and soybean 62.7 to 71.6%). The digestibility of protein from kabuli type is higher than that of desi types (Paredez *et al.* 1991).

Legume generally contains higher oil contents than cereals (Salunke *et al.* 1985). Significant ($p<0.05$) variation among the tested chickpea varieties was observed for crude oil content (Table 2).The crude oil contents of Koka (9.86%) and Hora (9.83%) were the highest compared to other varieties. The oil content of chickpea was reported to be 3.40-8.83 for kabuli and 2.90-7.42% for desi (Wood and Grusak, 2007). Similarly, the oil content of all varieties under this study was found to be within this range. According to Sharma *et al.* (2013), the oil content of kabuli (3.1-6.8%) was greater than desi cultivar (2.6- 5.6%). The report by Esayas *et al.* (2012) has shown that the oil content of chickpea was about 7.01% for Habru variety. These results are in line with the current result 8.34% crude oil content for Habru variety. Beruk (2015) has reported that the oil content of DZ 10-11 was 5.94% with small difference with the result obtained in this study for same variety was 8.03%. The difference may be due to soil, season, and agronomic factors.

Table 2: The proximate compositions of improved and promising Ethiopian chickpea varieties

Varieties	MC (%)	Ash (%)	CF (%)	CP (%)	CO (%)	CHO (%)	Energy(Kcal)
Akaki	9.00+0.33^{ab}	2.03+0.03^{g}	7.44+ 1.07^{d}	16.23+0.44^{f}	6.89+0.14^{j}	58.51+1.05^{cd}	360.54+5.09^{h}
Mariye	7.67+0.30^{def}	3.07+0.27^{def}	7.67+0.88^{d}	16.49+0.07^{ef}	7.32+0.18^{i}	57.79+0.87^{cdef}	363.00+3.70^{hi}
Tekataye	7.00+0.33^{g}	3.47+0.13^{cde}	7.41+1.81^{d}	18.58+1.58^{de}	8.82+0.02^{c}	54.73+2.55^{efgh}	372.58+7.26^{g}
Shasho	9.00+0.33^{ab}	3.07+0.40^{def}	2.93+0.27^{gh}	18.55+0.38^{de}	6.81+0.01^{j}	59.64+1.26^{abc}	374.06+3.63^{f}
Chefe	9.33+0.67^{a}	1.93+0.07^{g}	3.64+0.91^{fgh}	19.03+2.03^{cd}	7.85+0.03^{g}	58.22+0.52^{bcde}	379.60+6.64^{def}
Hora	6.33+0.33^{h}	2.03+0.03^{g}	3.75+0.92^{fgh}	19.10+0.18^{cd}	9.83+0.03^{a}	58.96+0.85^{bc}	400.68+3.20^{a}
Dhera	8.13+0.13^{cd}	2.69+0.03^{efg}	7.50+1.17^{d}	17.70+0.76^{def}	9.59+0.01^{b}	54.39+1.77^{fghi}	374.62+4.00^{fg}
Habru	8.97+0.30^{ab}	4.20+1.13^{bc}	3.97+1.92^{fgh}	16.70+0.57^{def}	8.34+0.04^{e}	57.84+2.08^{cdef}	373.15+9.57^{f}
Dz-10-11	7.43+0.10^{efg}	4.13+0.13^{c}	10.67+0.00^{ab}	18.80+0.68^{de}	8.05+0.02^{f}	50.93+0.47^{i}	351.29+1.008^{j}
Dimtu	8.10+0.10^{cd}	3.35+0.02^{cdef}	9.74+0.36^{abc}	18.46+0.76^{def}	8.09+0.01^{f}	52.26+0.42^{hi}	355.66+ 1.81^{hij}
Teji	6.24+0.24^{hi}	2.69+0.02^{efg}	4.22+0.60^{fg}	17.02+0.2^{def}	8.36+0.01^{e}	61.48+0.32^{ab}	389.22+ 1.43^{bc}
Worku	8.37+0.30^{bc}	3.83+0.17^{cd}	8.92+1.06^{bcd}	18.02+0.14^{def}	7.45+0.03^{i}	53.42+0.50^{ghi}	352.76+2.34^{ij}
Natoli	8.57+0.10^{bc}	3.16+0.04^{def}	8.65+0.67^{cd}	17.40+0.33^{def}	7.85+0.05^{g}	54.38+0.60^{fghi}	357.71+ 2.66^{hij}
Dubie	7.53+0.20^{def}	5.70+2.30^{a}	5.26+1.28^{ef}	17.80+0.51^{def}	5.85+0.15^{k}	57.85+3.91^{bcdef}	355.24+12.37^{hij}
Koka	8.03+0.03^{cde}	2.45+0.25^{fg}	3.13+0.47^{gh}	18.58+0.76^{de}	9.86+0.01^{a}	57.95+0.84^{bcdef}	394.80+1.62^{ab}
Arerti	5.60+0.93^{i}	3.74+0.26^{cd}	3.33+0.67^{gh}	16.48+0.94^{ef}	7.81+0.01^{g}	63.05+2.02^{a}	388.34+4.65^{bcd}
Dalota	9.37+0.70^{a}	2.01+0.01^{g}	11.22+2.11^{a}	16.78+0.51^{def}	8.84+0.04^{c}	51.79+2.04^{hi}	353.79+7.43^{hij}
Dz-10-4	6.13+0.13^{hi}	3.24+0.09^{cdef}	7.12+ 0.41^{d}	18.99+0.38^{cd}	8.34+0.04^{e}	56.18+0.79^{cdefg}	375.71+2.01^{efg}
Minjar	7.97+0.63^{cde}	2.03+0.69^{g}	7.07+1.74^{de}	21.36+4.22^{bc}	8.62+0.22^{d}	52.96+6.38^{ghi}	374.81+11.56^{fg}
Ac.Dub	7.70+0.37^{def}	3.34+0.01^{cdef}	3.61+0.27^{fgh}	19.76+0.16^{bc}	8.15+0.05^{f}	57.45+0.44^{cdef}	382.14+2.81^{cdef}
Ejeri	7.70+0.30^{def}	3.36+0.03^{cde}f	2.35+1.01^{h}	23.82+3.92^{a}	7.65+0.05^{h}	55.10+4.62^{defgh}	384.58+3.20^{cde}
Dz-2012-19	7.17+0.17^{fg}	5.15+0.18^{ab}	3.04+1.27^{gh}	22.60+0.76^{ab}	7.41+0.01^{i}	54.63+ 0.93^{efgh}	375.58+4.24^{efg}
Cv	1.10	1.10	2.87	2.26	0.96	3.60	14.90

Data were interpreted as Mean ± SD, varieties that share the same letters are not significantly different from one another ($p \leq 0.05$). Ac.Dub-Acos Dubie, CHO-carbohydrate, MC- moisture content, CF – Crude Fiber, CP- Crude protein, CO – Crude-Oil

There was significant ($p<0.05$) difference among the energy value of the cultivars. Worku (352.76) and DZ-10-11 (351.29 Kcal/100g) have scored the lowest energy value. The report by Beruk (2015) has revealed the result of Dz-10-11 (kabuli type) to be 388.12 Kcal/100g whereas (Nigozi *et al.* 2015) has reported that desi-type had the highest energy value (450.67 kcal/g). The current result shows that the energy content for this variety (Dz-10-11) was 351.29 Kcal/100g which was lower than the reported one. However, the result obtained from Arerti (388.34) variety was exactly similar with this reported result (388.12 Kcal/100g). The energy contents of kabuli and desi type chickpea were reported to be 371.91 and 322.58 Kcal/100g, respectively (Esayas *et al.* 2012). The results of kabuli was mostly similar with the result scored in this study. This high energy content of chickpea might make it essential crop to reduce problem of malnutrition in developing countries like Ethiopia.

Mineral Contents

The mineral contents of the studied chickpea varieties are presented in Table 3. The Fe content ranged from 3.2 mg/100g to 4.65 mg/100g. The highest Fe content was recorded from Akaki (4.65) and Natoli (3.06), both desi type. Esayas *et al.* (2012) reported that the Fe contents of Habru (kabuli) and Local (desi type) were 6.47 and 4.99 mg/100g, respectively. However, the recorded Fe content for the Habru variety was 3.56 mg/100g, which was lower than the reported result. Nevertheless, the Fe content of the desi type's variety was very similar.

Table 3 shows that the maximum average of Na content was recorded from Teji (21.06 mg/100g) which was significantly different from all other varieties analyzed under this study. The minimum average Na content was obtained from Arerti (3.74 mg/100g) variety. The highest average of Calsium (Ca) contents were recorded from Arerti (159.8 mg/100g) followed by Dz-10-11(157.69) with no statistical difference between them ($p>0.05$). The Ca content of kabuli variety was reported to be 143.25mg/100g (Beruk, 2015) which is in agreement with current result (157.69 mg/100g for Dz-10-11). The result reported by (Esayas *et al.* 2012) has shown that the Ca content of Habru (kabuli) and Mastewal (desi) were 147.47, 146.48 mg/100g, respectively. Most of the results obtained in this study were in agreement with the previous reports. For adolescent females (10-18 years) and males (10-18years) about 1300 mg Ca /Kg body weight/ day is required while for adult females (19-50) and adult males (19-65) about 1000 mgCa/Kg body weight/ day is required (WHO and FAO, 2004). The Ca content may seem low as compared with the recommended daily intake. But this can be replaced by consumption of some animal source foods.

There was a reported result that zinc (Zn) content in desi chickpea cultivars were 3.5 to 6.0 % (Zia-Ul-Haq *et al,* 2008). In current study, Zn content ranged from 2.38-3.86 mg/100g. The observed values were lower than the reported value. Both Arerti and Dz-2012-19 have scored the highest amount of Zn content 3.86 and 3.8 mg/100g, respectively. They were significantly different from all other varieties. Similar results were also reported for desi type by (Wang and Daun, 2004) which was 2.8 mg/100g. As reported by Esayas *et al.* (2012), the Zn content of Habru and Local (desi type) were 3.69 and 3.04 mg/100g, respectively. In addition, Beruk (2015) has also reported that the Zn content of Kabuli type was 2.55 mg/100g. The Zn result of chickpea varieties under this study ranged from 2.36 (Mariye) to 3.86 mg/100g (Arerti) which is in agreement with the previous reports.

In this experiment, all chickpea verities were significantly different ($p<0.05$). Dz-2012-19 (615.16 mg/100g) variety (kabuli type) has scored the highest mean of Phosphorus (P) content. The phosphorus content of Habru, Mastewal and Local (Desi type) chickpea were 375.24, 228.24, 216.35 mg/100g, respectively (Esayas *et al*. 2012). Some of the results obtained in current study were somewhat similar with these reported results while most of them were greater than the previous report. This difference may mainly come from equipment, agronomic and other related factors.

Table 3: The mineral content of improved and promising Ethiopian chickpea varieties (mg/100g)

Varieties	Fe	Na	Ca	Zn	P
Akaki	4.65+0.03^{a}	11.21+0.45^{cd}	145.69+2.45^{ab}	2.84+0.1^{cdef}	344.74+0.716^{j}
Mariye	4.00+0.12^{abc}	11.51+0.24^{c}	124.40+5.92^{bc}	2.36+0.06i	391.67+0.479^{h}
Tekataye	4.31+0.07^{abcd}	6.72+0.42^{g}	116.71+6.02^{bcd}	2.78+0.04^{defg}	503.07+0.856^{e}
Shasho	4.58+0.17^{ab}	4.88+0.14^{ij}	116.41+3.53^{bcd}	3.08+0.24^{c}	475.88+0.665^{f}
Chefe	3.57+0.03^{efg}	6.60+0.53^{g}	112.46+4.72^{cd}	3.06+0.13^{c}	475.37+0.521^{f}
Hora	2.45+0.39^{h}	13.34+0.53^{b}	111.23+3.73^{cd}	2.52+0.03^{hi}	392.57+0.543^{h}
Dhera	4.13+0.07^{abcd}	10.52+0.44^{cd}	112.75+2.88^{cd}	3.00+0.12^{cd}	364.05+0.239^{i}
Habru	3.56+0.19^{efg}	9.96+0.19^{de}	114.08+2.33^{cd}	3.49+0.08^{b}	503.16+0.725^{e}
Dz-10-11	3.82+0.01^{def}	8.73+0.34^{ef}	157.69+4.60^{a}	2.71+0.07^{efgh}	559.85+0.492^{c}
Dimtu	3.42+0.06^{fg}	11.64+0.49^{c}	90.19+11.10^{d}	2.62+0.01^{fghi}	363.84+0.23^{i}
Teji	3.88+0.07^{cdef}	21.06+0.61^{a}	114.51+3.95^{cd}	2.38+0.08^{i}	392.67+0.59^{h}
Worku	4.57+0.02^{ab}	11.59+0.56^{c}	156.1+9.3^{a}	2.84+0.05^{cdef}	419.90+ 0.70^{g}
Natoli	3.06+0.11^{g}	5.59+0.53^{ghi}	109.29+3.95^{cd}	2.57+0.04^{ghi}	419.83+0.30^{g}
Dubie	4.49+0.34^{ab}	5.06+0.26^{hi}	101.27+9.21^{cd}	2.87+0.07^{cdef}	587.85+0.49^{b}
Koka	3.80+0.32^{def}	6.58+0.35^{g}	93.92+4.06^{cd}	3.47+0.03^{b}	560.60+0.62^{c}
Arerti	3.87+0.2^{cdef}	3.74+0.38^{j}	159.8+5.6^{a}	3.86+0.07^{a}	531.68+0.60^{d}
Dalota	3.82+0.16^{def}	6.31+0.37^{gh}	107.09+7.06^{cd}	2.79+0.04^{defg}	559.33+0.61^{c}
Dz-10-4	3.45+0.04^{fg}	5.56+0.47^{ghi}	120.66+7.62^{bcd}	2.79+0.06^{defg}	420.95+0.99^{g}
Minjar	4.09+0.12^{bcde}	5.08+0.23^{hi}	156.66+4.66^{a}	2.54+0.06^{ghi}	503.01+1.25^{e}
Acos Dubie	3.89+0.08^{cdef}	8.10+0.25^{f}	96.89+9.55^{cd}	2.88+0.04^{cde}	587.88+0.47^{b}
Ejeri	3.20+0.26^{g}	12.97+0.41^{b}	107.81+4.86^{cd}	2.56+0.11^{ghi}	503.43+0.54^{e}
Dz-2012-19	4.39+0.24^{abc}	11.67+0.42^{c}	116.12+1.83^{bcd}	3.80+0.01^{a}	615.16+0.70^{a}
Cv	0.57	4.56	8.28	0.42	0.14

Data were interpreted as Mean ± SD, varieties that share the same letters are not significantly different ($p\leq0.05$). Where: Fe-Iron, Na-Sodium, Ca-Calcium, Zn-zinc, P- phosphorus

According to WHO and FAO (2004), about 4.3 mg/day to 14.4 mg/day is required for females of adolescent ages (10-18 years) whereas 5.1 to 17.1 mg/day is required for males of same age. However, for adult females (19-50) 3 to 9.8 mg /Kg body weight /day and adult males (19-65) 7 to 14 mg/Kg body weight /day). The consumption of chickpeas can be said to be an ideal source for Zn content, which is very important for growth.

Conclusion and Recommendation

Ethiopian improved and one promising chickpea varieties were analyzed for their nutritional compositions. The objective of this study was mainly to generate baseline information and robust quality database for almost all existing productive chickpea varieties. The proximate and minerals were analyzed to identify the difference between the varieties. The results of this study indicated that chickpea cultivars have good nutritional qualities. They can provide protein (16.23-23.82%) and Zn (2.38-3.86 mg/100g) and Fe (3.2-4.65 mg/100g). In view of the overall nutrient and proximate compositions, these chickpea varieties can be an economic and alternative protein source that could alleviate protein malnutrition in developing countries like Ethiopia. However, further studies need to be conducted on anti-nutritional factors and amino acid profiles of these varieties. From this study results, it could be recommended to use Ejeri variety (23.82), Minjar (21.36) and Acos Dubie (19.76%) for protein targeted breeding and food fortification purposes. For Fe improvement, Akaki (4.65), Shasho (4.58), Worku (4.57) and Dubie (4.49mg/100g) could be recommended while Ararti (3.86mg/100g) is the best for Zn fortification. The promising variety (Dz-2012-19) had better protein (22.60%) and Zn content (3.80mg/100g) next to Ejeri and Arerti, respectively, and breeders can use this data as complementary information to yield and disease resistance for selection of this variety.

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