GREENER JOURNALS

GREENER JOURNAL OF PLANT BREEDING AND CROP SCIENCE

ISSN: 2354-2292

Submitted: 23/10/2015 Accepted: 30/10/2015 Published: 26/03/2016

Subject Area of Article: Agriculture

Research Article (DOI: http://doi.org/10.15580/GJPBCS.2016.2.102315147)

Evaluation of Physicochemical Attributes of Potato (*Solanumtuberosum* L.) Varieties in Eastern Ethiopia

Habtamu G[1], Wahassu M[2] and Beneberu S[3]

[1]Awada Agricultural Research Sub-Center, P.O.Box 205 Yiregalem, Ethiopia.
[2]Haromaya University P.O.Box 138, Dire Dawa, Ethiopia.

*Corresponding Author's Email: habteline @gmail .com, Mobile: +251 922 490 318

ABSTRACT

In Ethiopia, a number of improved potato varieties have been released by different research centre and institution; with much emphasis for adaptability, productivity and late blight resistance, while it has been given less or no emphasis to physicochemical attributes. Therefore, field and laboratory studies were conducted to evaluate the effect of the growing environment on physicochemical attributes of 16 released potato varieties (Moti, Belete, Bubu, Ararsa, Gudenie, Bule, Gabissa, Marachare, Harchassa, Gera, Gorrebella, Guassa, Jalenie, Bedasa, Zemen and Chiro) and two local farmer's cultivars (Bette & Jarso). The genotypes were grown at Haramaya, Hirna andArberekete; all in eastern part of Ethiopia. The experiment was laid out in a Randomized Complete Block Design with three replications. The data were statistically tested and the result indicated the existence of statistically significant difference among genotypes for most of the traits. The maximum tuber geometric mean diameter (57.12mm^3), dry matter content (30.66%), starch content (79.267%) and specific gravity (1.0967) were observed for Belete variety. While the highest sphercity (92.00%) and pH value (6.8) were observed for Gera and Bule variety respectively. In the same manner, the highest surface area (17805.7mm^2) was observed for Moti variety whereas the highest total soluble solid content (7.34^{0}Brix) were observed Bubu variety. The result of the study revealedthat the genotype and the growing environment have a great influence on physicochemical attributes of potato tubers. This study suggested that the growing environment has significant influence on potato tuber physicochemical attributes. Therefore, testing genotypes across location becomes important to recommend varieties for design of grading, handling, processing and packaging systems.

Keywords: Potato varieties, growing environment, physicochemical attributes.

INTRODUCTION

Physical characteristics of agricultural products are the most important parameters in the design of grading, handling, processing and packaging systems. Among these physical characteristics, mass, volume, projected area, and centre of gravity are the most important ones in the handling systems (Peleg, 1985). Other important parameters are width, length, and thickness (Peleg, 1985). Knowledge of length, width, volume, surface area and centrelocation of mass, may be applied in the designing of sorting machinery, in predicting surface needed when applying chemicals, shape factor (sphericity), and yield in the peeling operation (surface area) (Wright *et al*., 1986). The physical and chemical characteristics of the potato tubers vary from one variety to another and within the same variety, depending on the growing conditions; like soil temperature and soil moisture, harvesting and handling conditions (Kumar *et al*., 2004). Therefore, the choice of variety and its growing environment is probably the most critical decision with respect to matching the tuber quality with intended market.

The dry matter and specific gravity variation in potato varieties are heritable and vary with location, year and the growing conditions (Stark *et al*., 2005; Kumlay *et al*., 2002). The specific gravity of potatoes has been shown different; among the different varieties grown under the same conditions and also for single variety when grown under different conditions (Love & Pavek, 1991). According to stark *et al. (*2005), potato varieties vary widely in their ability to accumulate starch in the tubers making the choice of variety to be probably the most critical decision with respect of matching tuber quality with intended market. According to Miranda & Aguilera (2006) and Kita (2002) the crisp texture of potato chips depends mainly on starch content of the potato tubers. The fact that the potato tubers are of a high starch content suggests that the most important contribution to the texture of processed potatoes is due to gelatinization of starch during heating (Miranda & Aguilera, 2006). Dupont *et al*, (1992) observed that the crusts of French fries processed from potatoes of high starch content were described as crispy. The textural changes that take place during frying are suggested to be associated with chemical and physical changes such as starch gelatinization and consequent dehydration (Bouchon *et al*, 2001).

Every factor that is a part of the environment has the potential to cause differential performance which is associated with genotype x environment interaction in potatoes. The entire variable encountered in producing a crop can be collectively called an environment, while every factor that is a part of the environment, has the potential to cause differential performance that is associated with genotype, genotype to environment interaction in potatoes (Bradshaw *et al*., 2007).

In Ethiopia, different research centres and institutions have released a number of improved potato varieties. In developing the varieties, much emphasis was given for adaptability, productivity per unit area and late blight resistance, while less or no emphasis was given to physicochemical attributes like dry matter content, total soluble solid, starch content, pH, specific gravity, tuber spercity, geometric mean diameter and surface area; which are very crucial quality parameters. Assessment of genotype × environment (including end use) interactions answers the adaptation to the environment and end uses because, it is unlikely that one of many potential new cultivars would be best in all environments and for all uses (Bradshaw *et al*., 2007). Therefore, an evaluation of the physicochemical properties of the varieties becomes paramount. So, this study was conducted with the following objective:

To evaluate and determine the tuber physical and chemical properties of potato genotypes in Eastern Ethiopian.

MATERIAL AND METHODS

Description of the study area

The field experiment was conducted under rain fed conditions in 2012 at Haramaya, Hirna and Arberekete; in Eastern Ethiopia. The latitude, longitude and altitude of the experimental sites are indicated in Table 1.

Experimental treatment and design

A total of 18 potato genotypes, 16 released potato varieties (Moti, Belete, Bubu, Ararsa, Gudenie, Bule, Gabissa, Marachare, Harchassa, Gera, Gorrebella, Guassa, Jalenie, Bedasa, Zemen & Chiro) and two local cultivars (Bette & Jarso) were used for this experiment. The experiment was laid out as a Randomized Complete Block Design (RCBD) with three replications. Each plot was 3.60 m x 4.50 m = 16.2 m^2 wide consisting of six rows, which accommodated 12 plants per row and thus 72 plants per plot. The spacing between plots and adjacent replication was 1m and 1.5m, respectively. At each site, medium sized (39-75g) Lung'aho *et al*., (2007) and well sprouted tubers were planted at the spacing of 75 cm between ridges and 30 cm between tube. Fertilizer was applied as the recommendation made by Haramaya University, which Phosphorus fertilizer was applied at the rate of 92kg P_2O_5 ha^{-1} in the form of Diammonium Phosphate (200kg ha^{-1}) and the whole rate was applied at planting while, Nitrogen fertilizer was applied at the rate of 75kg Nitrogen ha^{-1} in the form of Urea in two splits, half rate after full emergence (two weeks after planting) and half rate at the initiation of tubers (start of flowering). Potato plants were treated with Mancozeb 80% WP at the rate of 1.5 kg ha^{-1} diluted at the rate of 40 g per 20 litres of water once a week to control late blight disease. All other cultural practices were applied according to the regional (Haramaya University) recommendations. For data estimation, the tubers were harvested from middle rows, leaving the plants growing in the two border rows as well as those growing at both ends of each row to avoid edge effects.

Table 1: Descriptions of the experimental sites

Site	Latitude	Longitude	Altitude (m)
Haramaya	09°26' N	043°03'E	1980
Hirna	09°12' N	041°02'E	1870
Arberekete	09°14'N	041°46'E	2280

Data Collection

Geometric mean diameter (Dg) (mm): The sizes of ten randomly selected tubers from each plot were measured as length, width and thickness using digital caliper with an accuracy of 0.01 mm. The geometric mean diameter (Dg) was calculated by using the following equationdescribed by Ahmadi *et al*. (2008): $Dg = (LWT)^{0.333}$

Where, L is the length; W is the width and T is thickness of the tuber.

Sphericity of the tuber (Φ) (%): Tuber Sphericity were determined by the following formula described by Ahmadi *et al*. (2008): $\Phi = (Dg/L) \times 100$

Where, Φ is sphercity of the tuber, Dg is geometric mean diameter and L is length

Surface area (S) (mm^2): Tubers surface area was determined according to Baryeh (2001) by the following formula: $S = \pi Dg^2$

Where, S is surface area and Dg is geometric mean diameter

Specific gravity of tubers: A five kg tuber of all shapes and sizes were randomly taken from each plot and washed with water, and then weighted first in air then in water thereafter calculated using the following formula (Kleinkopf *et al*, 1987).

$$\text{Specific gravity} = \frac{\text{weight in air}}{\text{weight in air} - \text{weight in water}}$$

Moisture content (%): Moisture was determined by oven drying method. Five gram of each sample was accurately weighed in Petri dish (W1). The partially covered dish was placed in oven at 105°C for 12 hours. Then the Petri dish was placed in desiccators at room temperature for 30 minutes to cool. The sample was reweighed after cooling (W2). The percent moisture content was calculated as:

$$\text{Moisture (\%)} = \frac{(W1-W2)}{\text{Wt. of sample}} \times 100$$

Tuber dry matter content (%): Five fresh tubers were randomly selected from each plot and weighed at harvest, sliced and dried in oven at 65^{o}C; until a constant weight is obtained and dry matter content in percent were calculated according to Williams (1968).

$$\text{Dry Matter (\%)} = \frac{\text{weigh of sample after drying (g)}}{\text{intial weight of sample(g)}} \times 100$$

Total starch content (g/100g): The percentages of starch were calculated from the specific gravity as follows:, Starch (%) =17.546 + 199.07 × (specific gravity-1.0988) (Talburt and Smith 1959 as cited by Yildrim and Tokuşoğlu, 2005), where specific gravity was determined as indicated above by the weight in the air and weight in water method.

pH measurement: The pH of the raw potato tuber samples were determined using a method as described by Pardo*et al*., (2000). The pH was measured in the juice obtained after washing, crushing and extracting the juice of the sample tubers using pH meter.

Total soluble solids (^{0}Brix): The Brix of the raw potato samples was determined using a method as described by Pardo *et al*. (2000) using refracto meter. The Brix was measured in the juice obtained after washing, crushing and extracting juice of the tuber samples.

Data analysis

The data were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) of the Statistical Analysis System (SAS) statistical package.

RESULT AND DISCUSSION

Effects of the environment and the genotype on geometric mean diameter, sphericity and surface area of potato

The growing environment, genotype and the interaction significantly influenced the geometric mean diameter, sphericity and surface area (Appendix table 1).

Tuber geometric mean diameter: Significant maximum tuber geometric mean diameter was recorded for Moti (74.74mm^3) at Haramaya, Belete (57.12mm^3) at Arberekete and Harchassa (55.87mm^3) at Hirna, whereas, significant minimum tuber geometric mean diameter was registered for Jarso (50.28mm^3), Harchassa (53.14mm^3) and Jalenie (54.13mm^3); all were grown at Haramaya, Gudenie (46.08mm^3); at Arberkete and Jarso (47.38mm^3) at Hirna (Table 2).

Tuber sphericity: Significant maximum tuber sphericity was recorded for Gera (92.00%) grown at Haramaya, Ararsa (90.24%) followed by Bule (88.89%) both grown at Hirna, Bette (89.08%) followed by Gera (86.31%) both grown at Arberekete. Significant minimum tuber sphericity was registered for Belete (70.81%), Chiro (69.19%) and Zemen (72.26 %); varieties grown at Haramaya, Arberekete and Hirna, repectively (Table 2).

Tuber surface area: Significant maximum tuber surface area was recorded for Moti (17805.70mm^2) grown at Haramaya, Belete (10470.03mm^2) grown at Arberekete and Harchassa (9942.38mm^2) followed by Zemen (9830.67mm^2)both grown atHirna whereas, significant minimum tuber surface area was registered for Jarso (7951.32mm^2) grown at Haramaya, Gudenie(6698.79mm^2) grown at Arberkete and Jarso (7303.23mm^2) followed by Gera (7433.46mm^2)grown at Hirna (Table 2).

The tuber size directly influences crisp size, which in turn influences post-frying handling. In this study all the varieties produced <60mm^3 diameter at Hirna and Arberkete as well as Harchassa, Jalenie, Jarso and Bette produced tuber <60mm Dg at Haramaya. Therefore, all genotypes grown at Hirna and Arberkete produce tubers suitable for crisps processing. This is because, the larger tubers greater than 60 mm in diameter yield crisps; which are fragile, break easily during packaging, and transport (Kabira and Lemaga, 2006).

Effect of environment and genotype on total soluble solid, drymatter content, specific gravity and starch content of potato tuber

The total soluble solid, dry matter content and specific gravity of potato were significantly influenced by the growing environment and genotype (Appendix table 1).

Total soluble solid: In this study, total soluble solid contents ranged from 5.66^{0}Brix for Jarso to 7.34 ^{0}Brix for Bubu variety. Other varieties viz., Gera (7.32^{0}Brix), Belete (7.14^{0}Brix) and Bule (7.01^{0}Brix), also recorded the highest total soluble solids; while after Zemen (6.06^{0}brix), Marachare (6.21^{0}Brix) and Bette (6.22^{0}Brix) registered the lowest total soluble solids. The highest mean total soluble solid for genotype was observed for Haramaya (7.42Brix) growing site; while the lowest mean total soluble solid was observed for Hirna (6.0^{0}Brix) (Table 3). According to Rex Harrill (1989), Brix equals to percentage of sucrose and varies directly with plant quality. The refractive index of potato varies from poor 3^{0}Brix, average 5^{0}Brix, good 7^{0}Brix as long to excellent 8^{0}Brix (Rex Harrill, 1989). Accordingly, all the genotypes in this study had refractive index,from average to excellent quality index in relation to the total soluble solid content.

Table 2: The interaction effect of the location and genotype on tuber spercity, geometric mean diameter and surface area

Variety	Geometric mean diameter (mm^3) Haramaya	Arberkete	Hirna	Spercity (%) Haramaya	Arberkete	Hirna	Surface area(mm^2) Haramaya	Arberkete	Hirna
Moti	74.74^{a}	55.52^{ab}	52.72^{a}	79.86^{cdef}	76.32^{cde}	85.30^{abcde}	17805.70^{a}	9797.36^{ab}	8968.85^{a}
Belete	65.23^{bcde}	57.12^{a}	51.32^{a}	70.81^{h}	78.64^{bcd}	73.53^{fg}	13538.13^{bcd}	10470.03^{a}	8393.95^{a}
Bubu	63.00^{cde}	48.19^{fg}	53.94^{a}	76.91^{defg}	70.25^{g}	79.11^{def}	12486.52^{cd}	7301.89^{fg}	9465.52^{a}
Ararsa	65.80^{bcde}	54.56^{abc}	54.84^{a}	86.28^{b}	80.90^{bc}	90.24^{a}	13625.68^{bcd}	9365.01^{abc}	9790.69^{a}
Gudenie	68.05^{bc}	46.08^{g}	53.87^{a}	75.65^{fg}	70.95f^{g}	79.98^{cdef}	14570.17^{bc}	6698.79^{g}	9367.81^{a}
Bule	61.60^{de}	56.57^{ab}	52.36^{a}	86.47^{b}	82.04b	89.89^{a}	12035.67^{cd}	10114.63^{ab}	9019.12^{a}
Gabisa	64.35^{cde}	48.96^{efg}	53.85^{a}	74.30^{gh}	77.59^{bcd}	82.29^{bcde}	13141.17^{cd}	7605.32^{efg}	9524.43^{a}
Marachere	63.51^{cde}	50.36^{cdefg}	49.95^{a}	82.10^{bcd}	78.13^{bcd}	80.18^{cdef}	12720.06^{cd}	8020.99^{cdefg}	8021.05^{a}
Harchasa	53.14^{f}	49.56^{defg}	55.87^{a}	78.91^{cdefg}	75.15^{def}	81.67^{bcde}	8985.14^{ef}	7719.91^{defg}	9942.38^{a}
Gera	71.09^{ab}	55.94^{ab}	48.52^{a}	92.00^{a}	86.31^{a}	88.33^{ab}	15913.90^{ab}	9840.40^{ab}	7433.46^{a}
Gorrebella	66.49^{bcd}	50.02^{cdefg}	52.39^{a}	76.45^{fg}	72.56^{efg}	85.73^{abcd}	13993.09^{bc}	7902.79^{cdefg}	8679.37^{a}
Guassa	65.03^{cde}	51.95^{bcdef}	51.40^{a}	83.70^{bc}	76.69^{cde}	78.40^{efg}	13445.35^{cd}	8512.47^{bcdef}	8479.26^{a}
Jalenie	54.13^{f}	50.58^{cdefg}	51.56^{a}	82.79^{bc}	80.88^{bc}	84.28^{abcde}	9284.87^{ef}	8057.34^{cdefg}	8516.26^{a}
Bedasa	63.00^{cde}	49.18^{efg}	55.07^{a}	82.03^{bcd}	76.59^{cde}	81.84^{bcde}	12487.94^{cd}	7655.72^{efg}	9678.43^{a}
Zemen	61.71^{de}	53.41^{abcde}	55.40^{a}	76.16^{fg}	75.45^{de}	72.26^{g}	12052.06^{cd}	8967.29^{abcde}	9830.67^{a}
Chiro	63.97^{cde}	54.32^{abcd}	54.44^{a}	76.81^{efg}	69.19^{g}	83.73^{abcde}	12907.59^{cd}	9308.47^{abcd}	9596.59^{a}
Bette	59.69^{e}	54.45^{abc}	55.12^{a}	81.81^{bcde}	89.08^{a}	86.63^{abc}	11226.83^{de}	9432.66^{abc}	9704.24^{a}
Jarso	50.28^{f}	48.01^{fg}	47.38^{a}	79.84^{cdef}	72.35^{efg}	80.15^{cdef}	7951.32^{f}	7273.13^{fg}	7303.23^{a}
Significance	**	**	**	**	**	**	**	**	**
CV (%)	8.97	8.62	16.83	6.06	5.51	7.65	18.35	17.65	33.93

*, & ** = Significant at P<0.05 and P<0.01, respectively.
CV (%) = Coefficient variation in percent.

Means followed by the same letter with in a column are not significantly different.

Dry matter content: Dry matter content ranged from 20.92% (Jarso) to 30.66% (Belete). Other varieties, Bubu (27.49%) and Gorrebella (27.48%) also registered the highest dry matter content, while Bette (20.73%) and Moti (23.47%) exhibited the lowest dry matter content. The highest mean dry matter content for the genotype was observed for Haramaya (27.26%) growing site; while the lowest mean dry matter content was observed for Hirna (21.95%) (Table 3). Potato crisps processing requires tubers with dry matter content of greater or equal to 20% and specific gravity of greater or equal to 1.080 (Kabira and Lemaga, 2006). The dry matter is one ofthe important traits after yield, since the genotypes, which have more dry matter percentage have more importance for the industrial, economic purposes and also storage property.Thedrymatter content of potato tubers determines the suitability for chip processing purposes by influencing the chip yield, texture flavour, final oil content and process efficiency (Kumlay *et al*., 2000; Kaaber *et al*., 2001). There is a strong link between the texture of potato chips and dry matter content of potatoes (Lisinska, 1989). The potato chips from potatoes of high dry matter content (above 25%) can exhibit hard textures, where those of low dry matter contain much oil, are greasy and sticky (Lisiska, 1989). Accordingly, all the genotypes under this study were suitable for chips making potential since the dry matter content of genotypes was greater than 20%. Moreover, Belete, Bubu, Gorrebella, Gudenie, Guassa, Gera, Bule, Jalenie and Zemen having above 25% dry matter content and exhibit hard texture chips and best for chips production.

Specific gravity: The specific gravity of genotype varied from 1.0534forJarso as Long to 1.0967 for Belete. Similarly, Gorrebella (1.0934) and Bubu (1.0925) exhibited the highest specific gravity while Bette (1.0684) and Ararsa (1.0802) registered the lowest specific gravity. The potato crisps processing requires tubers with dry matter content of greater or equal to 20% and specific gravity of greater or equal to 1.080 (Kabira and Lemaga, 2006). Anonymous (1991) as reported by Elfinesh (2008), the specific gravity in potatoes is very variable and may range between 1.050-1.1106. The potato tuber specific gravity and dry matter content are very important characteristics in determining suitability of the variety for crisps. Tubers with the high specific gravity generally gives the higher yields of crisps, hasa lower oil absorption and a better texture and therefore; is more economical to process (Lulai and Orr, 1979; Burton, 1989).

Kabira and Berga (2003) showed that potato should have a specific gravity value of more than 1.080 and potato tubers with specific gravity value less than 1.070 are generally unacceptable for processing. Therefore, all the genotype in this study except Jarso (1.0634) and Bette (1.0684) the two local farmers varieties, had specific gravity greater than 1.080 that is recommended for crisps processing in relation to specific gravity.

Table 3: the effect of location and genotype on dry mater, total soluble solid and specific gravity

Treatment	Parameter MC (%)	DM (%)	TSS(^{0}Brix)	SG
Location				
Arberkete	74.07^{b}	25.93^{b}	6.36b	1.0866^{a}
Haramaya	72.75^{c}	27.26^{a}	7.42^{a}	1.0826^{b}
Hirna	78.05^{a}	21.95^{c}	6.00^{c}	1.0840^{ab}
Significance	**	**	**	Ns
Variety				
Moti	76.53^{b}	23.47^{e}	6.90^{abcd}	1.0851^{bcd}
Belete	69.34^{f}	30.66^{a}	7.14^{ab}	1.0967^{a}
Bubu	72.51^{e}	27.49^{b}	7.34^{a}	1.0925^{ab}
Ararsa	76.38^{b}	23.62^{e}	6.22^{efg}	1.0802^{cd}
Gudenie	73.18d^{e}	26.82^{bc}	6.92^{abcd}	1.0907^{ab}
Bule	74.40^{bced}	25.60^{bcde}	7.01^{abc}	1.0871^{bcd}
Gabisa	75.52^{bcd}	24.48^{cde}	6.47^{cdef}	1.0856^{bcd}
Marachere	76.48^{b}	23.52^{e}	6.21^{efg}	1.0803^{cd}
Harchasa	75.61^{bcd}	24.40^{cde}	6.57^{bcdef}	1.0841^{bcd}
Gera	74.19^{bcde}	25.81^{bcde}	7.32^{abc}	1.0880^{ab}
Gorrebella	72.52^{e}	27.48^{b}	6.37^{def}	1.0934^{ab}
Guassa	73.27^{dce}	26.73^{bcd}	6.92^{abcd}	1.0899^{ab}
Jalenie	74.46^{bcde}	25.54^{bcde}	6.57^{bcdef}	1.0871^{bcd}
Bedasa	76.26^{b}	23.74^{e}	6.73^{bcde}	1.0757^{de}
Zemen	74.49^{bcde}	25.51^{bcde}	6.06^{fg}	1.0857^{bcd}
Chiro	75.71^{bc}	24.23^{de}	6.34^{def}	1.0853^{bcd}
Bette	79.27^{a}	20.73^{f}	6.22^{efg}	1.0684^{ef}
Jarso	79.08^{a}	20.92^{f}	5.66^{g}	1.0634^{f}
Significance	**	**	**	**
CV	3.01	9.01	8.66	0.81

MC=moisture content, DM=dry matter content, TSS=total soluble content, SG=specific gravity
*, & ** = Significant at P<0.05 and P<0.01, respectively.
CV (%) = Coefficient variation in percent.

Means followed by the same letter with in a column are not significantly different.

Starch content and pH value

In this study, starch content and pH value were significantly affected by the genotype, location and the interaction effect (Appendix table 1).

Starch content: the significantly highest starch content was recorded for Belete (16.63%) at Haramaya, Belete (17.60%), Gorrebella (17.43%) followed by Bubu (17.00%) at Arberekete and Belete (17.17%) at Hirna; whereas the significantly lowest starch content was registered for Jarso (8.8%) and Bette (9.10%) at Haramaya, Jarso (10.03%) at Arberkete and Jarso (12.27%), Bette (12.27%) followed by Ararsa (12.93%) at Hirna (Table 4).

The high starch content is favoured by the processors since it ensures the products have an acceptable texture and keeps processing costs down by limiting the amount of raw products needed, the cooking time required, and the amount of oil absorbed. According to stark *et al. (*2005), potato varieties vary widely in their ability to accumulate starch in the tubers making the choice of variety to be probably the most critical decision with respect to the matching tuber quality with intended market.

pH: The significantly highest pH value was recorded for Bule (6.80) at Haramaya, Bule (6.63) and Guassa (6.63) both grown at Arberekete and Gabissa (6.53)and Harchassa (6.53) both grown at Hirna; whereas, significant minimum pH value was registered for Ararsa (6.07) at Haramaya, Gabissa (6.20) at Arberkete and Ararsa (6.10) at Hirna (Table 4).This finding is in contrast with the findings of (Elfinesh, 2008); who reported that pH of raw potatoes was not significantly influenced by the interaction effect of the variety and growing environment.

The pH index determines deterioration potentials by fermentation and the activity of enzymes. The phosphorylase enzyme acts predominantly on starch breakdown (Jadhav *et al*., 1991), with maximum activity at pH 5.5 (Iritani & Weller, 1973). Invertase, on the other hand, promotes sucrose breakdown into glucose and fructose (Sowokinos, 1990), and presents an optimum point at pH 4.7 (Pressey, 1966). In addition, pulp pH is variable and presents a negative correlation with reducing sugars accumulation (Iritani& Weller, 1973).

Table 4: the interaction effect of location and genotype on pH and starch

Variety	pH Haromaya	Arberkete	Hirna	Starch (%) Haromaya	Arberkete	Hirna
Moti	6.30^{e}	6.47^{abc}	6.37^{ab}	14.13^{de}	15.60^{a}	14.40^{abcd}
Belete	6.30^{e}	6.30^{bcd}	6.27^{ab}	16.63^{a}	17.60^{a}	17.17^{a}
Bubu	6.47^{c}	6.37^{bcd}	6.37^{ab}	16.20^{ab}	17.00^{a}	16.30^{ab}
Ararsa	6.07^{g}	6.27^{cd}	6.10^{b}	11.57^{f}	15.40^{ab}	12.93^{cd}
Gudenie	6.50^{c}	6.43^{abcd}	6.43^{ab}	15.70^{abcd}	15.83^{a}	16.23^{ab}
Bule	6.80^{a}	6.63^{a}	6.37^{ab}	15.53^{abcd}	16.80^{a}	13.87^{bcd}
Gabisa	6.33^{e}	6.20^{d}	6.53^{a}	14.20^{cde}	15.10^{ab}	16.17^{ab}
Marachere	6.40^{d}	6.37^{bcd}	6.23^{ab}	14.70^{bcde}	14.40^{ab}	13.43^{bcd}
Harchasa	6.40^{d}	6.40^{abcd}	6.53^{a}	14.43^{bcde}	15.73^{a}	13.80^{bcd}
Gera	6.20^{f}	6.27^{cd}	6.30^{ab}	15.07^{abcd}	15.93^{a}	15.37^{abc}
Gorrebella	6.4^{c}	6.47^{abc}	6.33^{ab}	15.60^{abcd}	17.43^{a}	16.37^{ab}
Guassa	6.60^{b}	6.63^{a}	6.33^{ab}	16.00^{abc}	16.13^{a}	15.17^{abc}
Jalenie	6.60^{b}	6.53^{ab}	6.30^{ab}	15.60^{abcd}	15.87^{a}	13.97^{bcd}
Bedasa	6.50^{c}	6.50^{abc}	6.27^{ab}	13.27^{e}	14.97^{ab}	13.57^{bcd}
Zemen	6.63^{b}	6.37^{bcd}	6.40^{ab}	16.50^{b}	15.57^{a}	13.23^{bcd}
Chiro	6.50^{c}	6.30^{bcd}	6.33^{ab}	14.43^{bcde}	15.33^{ab}	14.80^{abc}
Bette	6.30^{e}	6.43^{abcd}	6.40^{ab}	9.10^{g}	11.83^{bc}	12.27^{cd}
Jarso	6.40^{d}	6.37^{bcd}	6.36^{ab}	8.80^{g}	10.03^{c}	12.27^{cd}
Significance	*	*	*	*	*	*
CV (%)	0.47	1.96	2.66	6.53	12.62	11.03

*, & ** = Significant at P<0.05 and P<0.01, respectively.
CV (%) = Coefficient variation in percent.

Means followed by the same letter with in a column are not significantly different.

SUMMARY AND RECOMMENDATION

In this study, all the varieties produced <60mm diameter at Hirna and Arberkete. Hence, it is suitable for crisps processing. All the genotypes in this study had refractive index of average to excellent quality index in relation to the total soluble content. In this study, all genotypes, except Jarso (1.0634) and Bette (1.0684), the two local farmer's varieties, had specific gravity greater than 1.080 that is recommended for crisps processing in relation to specific gravity. Belete, Gorrebellafa and Buba varieties having high starch content, have to be favoured by the processors since high starch content ensures the products have an acceptable texture and keeps processing costs down by limiting the amount of raw products needed, the cooking time required, and the amount of oil absorbed. All the genotypes under this study were suitable for chips making potentials, since the dry matter content of genotypes was greater than 20%. Moreover, Belete, Bubu, Gorrebella, Gudenie, Guassa, Gera, Bule, Jalenie and Zemen having above 25% dry matter content can exhibit hard texture chips so that they are best for chips production in relation to dry matter content.

ACKNOWLEDGMENT

I am excited to acknowledge Haramaya University potato research program for covering all the financial expenses. My special thanks go to Haramaya University field assistances for their unreserved support and substantial contribution towards the accomplishment of this job successfully. I am also grateful to Horticulture Laboratory workers such as, Abebawu Kabite, Tsehay H/mariam, Yimenashu Kasaye and Abera Girma; for their cooperation and assistance during the laboratory work. I am very much thankful to the Department of Food Science and Postharvest Technology, Soil Science and Horticulture of Haramaya University for their permission to use their laboratory facilities for quality analysis and for their technical support during the work.

REFERENCE

Ahmadi H., Fathollahzadeh H., Mobli H., (2008). Some Physical and Mechanical Properties of Apricot Fruits, Pits and Kernels (cv.*Tabarzeh)*.American-*Eurasian J.Agric. Environ. Sci.*3(5): 703-707.
Baryeh E., (2001). Physical properties of Bambara groundnuts.Journal of Food Engineering 47(4), 321-326.
Bouchon P.,Hollins P., Pearson M., Pyle D., and Tobin M., (2001).Oil distribution in fried potatoes monitored by infrared microspectroscopy.*J Food Sci*. 66, 918-923.
Bradshaw J,,Gebhardet C., Goves F., Mackerron K.L., Mark A., Taylor M. and Ross H., (2007). Potato biology and bitechnology advances and perspectives.
Burton W.G., (1989).The potato, 3rd Edition, Longman Scientific and Technical, Harlow, Essex, UK.
Dupont M. S., Kirby A. R. & Smith A.C., (1992). Instrumental and sensory tests of texture of cooked frozen French fries. Int. J. Food Sci. Thcno. 27, 285-295.
Elfinesh F., (2008). Processing quality of improved Potato (*Solanumtuberosum*L.) varieties as influenced by growing environment, genotype and blanching. An M. Sc. Thesis submitted to the school of graduate studies of Haramaya University
Fehr W., (1987). Principles of Cultivar Development.Theory and Technique.Mcgram- hill, New York. 368p.
Kaaber L, Brathen E, Martinsen B &Shomer I., (2001). The effect of storage conditions on chemical content of row potatoes and texture of cooked potatoes. Pototato research, 44, 153-163.
Kabira J, and Berga L,, (2003). Potato processing quality evaluation procedure for research and food industry applications in east and central Africa.*Kenya Agric. Res. Insti.*Nairobi.
KabiraJ. and Lemaga B., (2006). Potato Processing: Quality Evaluation procedures for research and food industries applications in East and Central Africa. Kenya Agricultural Research Publication, Nairobi, Kenya.10 p.
Kita A., (2002). The influnce of potato chemical compostion on crisp texture. Food Chmistry, 76, 173-179.
Kleinkopf G. and Westermann D., (1987).Specific Gravity of Russet Burbank Potatoes.*American Potato Journal*.64: 579-587.
Kumar D. and Ezekiel R., (2004). Distribution of Dry Matter and Sugars within a tuber of potato cultivars grown under short day conditions. *Potato J*. 31(3- 4): 130.
Kumlay A., Kaya C., Olgun M., Dursun A., Pehluvan M.,&Dizikisa T., (2002). Comparison of seasonal change of specific gravity, dray matter accumulation and starch content of four potato (*Solanumtuberosum* L.) varties. *ActaHorticalture*, 579, 255-258.
Love S.&Pavek J. (1991). Relationship of clonal mean to the uniformity and stability of tuber specific gravity in potatoes.*Am. Potato J*, 68, 543-550.
Lulai E.& Orr P. (1979). Influence of potato specific gravity on yield and content of chips. *Am. potato J*, 56, 379-390.
Miranda M.& Agulera J. (2006). Stracture band texture properties of fried potato products. Food Reviews international, 22, 173-201.
Pardo J.E., Alvarruiz A, Perez J, Gomez R and Varon R (2000).Physical-chemical and sensory quality evaluation of potato varieties. J. Food Quality. 23: 149-160.
Peleg K., (1985). Produce handling, packaging, and distribution. The AVI Publishing Company. Inc. Westport, Connecticut, 55–95.
Pressey R., (1966). Potato sucrose synthetase: purification, properties, and changes in activity associated with maturation. Plant Physiology, v.44, p.759-764
Rex H (1998). Using a refractometer to test the quality of fruits & vegetables.Published by Pineknoll company; Keedysville, MD 21756
Wright M. E., Tappan J. H. and Sister F. E. (1986).The size and shape of typical sweet potatoes.Transactions of the ASAE, 29(3), 678–68.
Yildrim Z andTokusogluÖ (2005). Some analytical quality characteristics of potato (*Solanumtuberosum*L.) Minitubers (cv.nif) developed via in -vitro cultivation, *Electronic Journal of Environmental, Agricultural and Food Chemistry*, ISSN: 1579-4377

Cite this Article: Habtamu G, Wahassu M and Beneberu S (2016). Evaluation of Physicochemical Attributes of Potato (*Solanumtuberosum* L.) Varieties in Eastern Ethiopia. Greener Journal of Plant Breeding and Crop Science, 4(2): 027-036, http://doi.org/10.15580/GJPBCS.2016.2.102315147

APPENDIXTABLE

Appendix table 1Mean squares for chemical attributes parameters of potato genotypes grown at Haramaya, Hirna and Arberkete and their interaction

S.V	d.f.	Mean square MC	DM	TSS	pH	SC	SG	Dg	S	SA
Var	17	50.917**	50.91**	1.7788**	0.0997*	22.826**	0.0005**	6198.4**	1122.3**	830836564**
Loc	2	410.77**	410.99**	29.442**	0.1454**	17.608**	0.0002 ns	203.73**	509.49**	28033568**
Var*Loc	34	6.8957 ns	6.8889 ns	0.4737 ns	0.0367**	5.4148**	0.0001 ns	137.58**	101.46**	19848950**
Error	106	5.09	5.10	0.33	0.02	2.02	0.0001	43.63	27.13	5661983

Where: MC= Moisture content DM= Drymatter SS= Total soluble solid SC= Starch content
SG= Specific gravity Dg=Geometric mean diameter S= Spercity SA= Surface area
** Significant at P < 0.01, * Significant at P < 0.05, ns non significant at P < 0.05 probability level. S.V: source of variation, d.f: degree of freedom.