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Research Article

Evaluation of Food Quality of Released Maize Varieties Grown in Oromia, Ethiopia

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Abstract

Maize is widely produced in Ethiopia and is mostly used for human consumption. Considerable efforts are being made by agricultural researchers to release different maize varieties and adaptations according to different agro-ecology. However, there is an information gap on the physic-chemicals of food qualities and the consumer's preference for all maize varieties. Thus, this study was conducted to evaluate the food quality of released food maize varieties through physical, chemical and sensory evaluation. Fifteen released maize varieties were collected from different agricultural research centers. The physicochemical attributes of these varieties were analyzed with three replications. Sensory evaluation was also performed by using the hedonic scale method. Thousand kernel weight, moisture, oil, protein, starch, ash, sodium, calcium potassium, and phosphorus contents were determined in the range of 152.81 – 479.45 grams, 9.54 – 12.97%, 3.78 – 4.86%, 7.07 – 11.76%, 77.75 – 81.27%, 0.64 – 1.12%, 228.75 – 3.02.33 ppm, 225.65 – 332.34 ppm, 1626.34 – 2714.51 ppm and 956.95 – 1452.86 ppm, 305.42 – 716.91 ppm and 811.50 – 1731.10 ppm, respectively. Overall acceptability of porridge and Injera prepared from maize varieties were on the scale of neither like nor dislike to like moderately. There were significant (P<0.05) variations in physical, chemical and organoleptic properties due to maize varieties variation. BH540, BH661 and Limu maize varieties had higher starch content and white color that gave them better acceptance value than those varieties with higher protein content and yellow color such as Melkasa 1, Melkasa seven, and Melkasa IQ maize varieties.

Keywords

Maize, Variety, Physical, Chemical, Sensory, Injera, Porridge

1. Introduction

Maize (Zea mays L.) is one of the most important cereal crops in Ethiopia and is mainly used for human consumption. In Ethiopia, maize is currently produced by more farmers than any other crop [1]. Cereals were cultivated on over 14 million hectares and provided over 260 million quintals yield between 2016/2017 and 2017/18 cropping season. Teff, maize, sorghum, wheat, barley and other crops share 30%, 21%, 19%, 17%, 10% and 3%, respectively for the area of production, while maize was ranked first (31%) and takes lion share for yield followed by teff (20%), sorghum (19%), wheat (17%) and others (5%) [2]. Among the top 25 maize producing districts, 15 are found in Oromia [3]. Approximately 88% of maize produced in Ethiopia is consumed as food, both as green and dry grain. Maize is the most important staple in terms of calorie intake in rural Ethiopia [4]. Berhane et al. also reported Maize accounted for 16.7% of the national calorie

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intake followed by sorghum (14.1%) and wheat (12.6%) among the major cereals [5]. It contains about: 73.4% (61.5-77.4%) of carbohydrates, 8.3% (6.3-10.9%) of Protein, 2.2% (1.4-3.8%) of crude fiber and 1.3% (0.6- 1.7%) of ash content [6].

National and regional research centers found in the Oromia regional state are releasing, adopting/adapting and/or verifying nationally and internationally released varieties as to their significance to agro-ecology basis. According to the Ethiopia Ministry of Agriculture report; about 64 maize varieties were released until 2017. These so-far released maize varieties were mainly evaluated based on agronomic performance, especially on yield, moisture stress and pest-resistant advantages. However, there are data gaps on physico-chemical food qualities at the same time the consumer's preference for these released maize varieties. Thus, it is crucial to establish baseline data on physicochemical and consumers' preference for different maize varieties produced in Oromia Region to address nutrition issues in the study area. Therefore, the present study was conducted to evaluate the physico-chemicals and processed food qualities of most maize varieties grown in Oromia, Ethiopia.

2. Materials and Methods

Study Site and Sample Collection

Fifteen released maize varieties were collected from Fedis Agricultural Research Center, Sinana Agricultural Research Center, Melkasa Agricultural Research Center, Bako National Maize Research Center and Ambo Plant Protection as listed in Table 1. Maize grains that were not damaged were chosen and stored under ambient temperate storage conditions until analysis. Laboratory analysis was done at Oromia Agricultural Research Institute (IQQO); Food Science Laboratory and Sinana Agricultural Research Center. While, maize Injera and porridge prepared from different maize varieties were evaluated by purposively selected IQQO's staff and development agents, agronomists and six farmers' research groups having every fifteen members selected from Bako Tibe and Horo Guduru districts, Oromia region.

Table 1. *List of Maize varieties and some of their agronomy data [7, 8].*

S. No	Variety name	Color	Adaptation area	Yield (qt/ha)		Breeder	Year of released	Type
				Research field	Farmer's field			
1	BH 540	White	1000- 1200	29- 42	24 - 31	BAKO NMRC/EAR	1995	Hybrid
2	BH 661	White	1600-2200	95-120	65-85	BAKO NMRC/EAR	2011	Hybrid
3	Wabi	White	No data	No data	No data	APRC (EIAR)	2012	Hybrid
4	Kulani	White	1700-2200	60-70	40-45	BARC	1990s	OPV
5	Hora	White	1000- 1200	60-70	40-45	ND	2005	
6	Limu	White	No data (ND)	ND	ND	Pioneer hi-bred seed in Ethiopia	2012	Hybrid
7	Jibat	White	ND	ND	ND	Ambo PPRC	2009	
8	Melkasa 6Q	White	LMS	45-55	30-40	MARC/EIAR	2008	OPV
9	Melkasa 7	Yellow	LMS	45-55	30-40	MARC/EIAR	2008	OPV
10	Melkasa 5	White	LMS	40-50	35-40	MARC/EIAR	2008	OPV
11	Melkasa 4	White	LMS	35-45	30-35	MARC/EIAR	2006	OPV
12	Melkasa 3	White	LMS	50-60	45-50	MARC/EIAR	2004	
13	Melkasa 2	White	LMS	55-65	45-55	MARC/EIAR	2004	OPV
14	Melkasa 1	Yellow	LMS	35-45	25-35	MARC/EIAR	2001	OPV
15	Melkasa 1Q	Yellow	LMS			MARC/EIAR	2013	OPV

Where; LMS=low moisture stress, MARC=Malkessa Agricultural Research Center, EIAR=Ethiopian Inistitute of Agricultural Research

2.1. Consumer Preference Test on Processed Food

Before conducting sensory evaluation; orientation was givento panelists with practical demonstration. Forty and eighteen consumers including researchers, farmers, and nutrition and plant science experts were purposely selected to determine the acceptability of maize porridge and Injera respectively.

Sample Preparations for Analysis

Maize varieties were sorted, cleaned, milled, sieved and stored at room temperature until chemical and sensory analysis carried out.

2.2. Physical and Chemical Analysis

Thousand seed weight (TSW) (g):

Random samples of one thousand seeds were taken by seed counter and weighed by an electric digital balance and accuracy 0.001g. The weight of each test had three replicates [9].

2.3. Nutrient Composition

Maize grain moisture, oil, starch and protein contents were determined by using a Mininfra Smart Nit grain analyzer; while, minerals such as iron, zinc and calcium contents were analyzed by using AOAC Official Method 975.03 [10] All determinations were done in triplicate.

2.4. Sensory Evaluation

Maize porridge and Injera were prepared and given for panelists to evaluate its organoleptic properties (color, taste, texture, odor, gas hole distribution and overall acceptability) using a 9-point hedonic scale. Where the scales include: 1=Dislike extremely, 2= Dislike very much, 3=Dislike moderately, 4=Dislike slightly, 5=neither like nor dislike, 6=like slightly, 7. Like moderately, 8. Like very much and 9=like extremely.

2.5. Data Analysis

Means and standard deviations were calculated for physic-chemicals and acceptability of the sensory attributes. All recorded data were subjected to SAS version 9.00 to test ANOVA.

3. Results and Discussions

3.1. Some Physical and Chemical Composition in Selected Maize Varieties

Data on the thousand kernel weight, moisture, oil, protein and starch content of different maize varieties were presented in Table 2. All recorded data were reported as mean with standard deviation (SD) at dry weight basis. BH540 Maize Variety had the highest weight (479.45 grams) while Melkasa 6 had the lowest weight (152.81 grams). The thousand kernel weight (TKW) result showed that there were significant differences (P<0.05) among the varieties.

Table 2. Physical and chemical content of maize varieties on dry basis.

S. N	Maize varieties	TKW (grams) ± SD	Moisture (%) ± SD	Oil (%) ± SD	Protein (%) ± SD	Starch (%) ± SD
1	BH661	354.03 ± 22.13^{fe}	10.4 ± 0.10^{e}	4.51 ± 0.14^{ed}	8.04 ± 0.06^{f}	79.39 ± 0.33^{ed}
2	BH450	479.45 ± 28.56^{a}	9.88 ± 0.05^{g}	4.74 ± 0.07^{ba}	7.08 ± 0.09^{g}	79.96 ± 0.50^{cb}
3	Hora	339.77 ± 5.93^{f}	11.33 ± 0.12^{b}	4.73 ± 0.07^{ba}	9.71 ± 0.13^{d}	79.62 ± 0.15^{cd}
4	Huluka	341.17 ± 20.80^{fe}	10.40 ± 0.10^{e}	4.68 ± 0.14^{bc}	9.49 ± 0.23^{d}	78.53 ± 0.16^{f}
5	Jibat	447.12 ± 8.48^{b}	10.67 ± 0.06^{d}	4.54 ± 0.18^{ecd}	10.38 ± 0.12^{c}	79.07 ± 0.11^{e}
6	Kolba	380.31 ± 1.14^{d}	10.60 ± 0.10^{d}	4.78 ± 0.06^{ba}	10.34 ± 0.04^{c}	78.41 ± 0.20^{f}
7	Kulani	360.12 ± 4.95^{e}	12.97 ± 0.15^{a}	4.86 ± 0.06^{a}	10.33 ± 0.14^{c}	81.27 ± 0.10^{a}
8	Limu	432.47 ± 28.87^{cb}	9.86 ± 0.17^{g}	4.47 ± 0.09^{e}	7.07 ± 0.21^{g}	80.25 ± 0.69^{b}
9	Melkasa 6Q	152.81 ± 4.50^{j}	9.89 ± 0.04^{g}	3.80 ± 0.11^{g}	11.76 ± 0.29^{a}	77.83 ± 0.33^{g}
10	Melkasa IQ	311.72 ± 6.69^{g}	10.10 ± 0.00^{f}	4.47 ± 0.06^{e}	10.62 ± 0.21^{c}	77.86 ± 0.11^{g}
11	Melkasa 1	305.15 ± 2.68^{hg}	10.10 ± 0.00^{f}	4.67 ± 0.22^{bcd}	11.04 ± 0.47^{b}	77.79 ± 0.06^{g}
12	Melkasa 7	234.6 ± 2.49^{i}	11.37 ± 0.06^{b}	4.2 ± 0.03^{f}	11.09 ± 0.29^{b}	79.17 ± 0.06^{e}
13	Melkasa 4	159.22 ± 2.38^{j}	9.54 ± 0.05^{h}	3.78 ± 0.03^{g}	9.77 ± 0.45^{d}	77.75 ± 0.24^{g}
14	Melkasa 2	286.59 ± 2.66^{h}	10.23 ± 0.06^{f}	4.69 ± 0.10^{bc}	9.08 ± 0.25^{e}	79.21 ± 0.18^{ed}

S. N	Maize varieties	TKW (grams) ±SD	Moisture (%) ±SD	Oil (%) ±SD	Protein (%) ±SD	Starch (%) ±SD
15	Wabi	425.48±12.14^{c}	10.9±0.10^{c}	4.67±0.08^{bcd}	7.70±0.09^{f}	80.21±0.15^{b}
Mean		334.00	10.55	4.51	9.57	79.09
CV		3.52	0.86	2.19	2.56	0.34
LSD (p<0.05)		19.66**	0.15**	0.16**	0.41**	0.45**

Where: In each column means followed by different letters (a, b, c, d, e, etc.) are significantly different at $\alpha < 0.05$, and **= strongly significant at P<0.0001

The mean values obtained for MC of maize varieties ranged from 9.54% (Melkasa 4) to 12.97% (Kulani) agreed with the range of moisture content of 7 and 5 maize varieties reported by [11, 12] which were between 9.42 to 11.45% and 8.96 to 12.45% respectively. 7.08 to 11.76% mean protein concentration was determined. The highest concentration of protein (11.76%) was found in the Melkasa 6 Q variety and the lowest in Limu (7.08%). There was a significant difference (P<0.05) among maize varieties. Protein content in this study relatively agrees with three maize varieties grown in Nigeria in the range of 10.67 – 11.27% for the maize grain [13], and Ikram also reported with the ranges between 7.71 – 14.60% in ten maize varieties [14].

The selected maize varieties oil content ranged from 3.78% (Melkasa 4) to 4.86% (Kulani). Oil content in maize varieties were significantly different (P<0.05). The starch content of determined maize varieties were ranged from 77.75% - 81.27% with significant differences occurring between all the varieties where Melkasa 4 had the lowest and Kulani the highest. Starch is the most important, abundant, digestible food polysaccharide and is therefore a major source of energy in our diets.

3.2. Ash and Mineral Composition of Different Maize Varieties

Ash content ranged from 0.64% (Melkasa 2) to 1.12% (Jibat, Kolba and Melkasa 1). There was significant difference (P<0.05) among maize varieties in ash content except among Jibat, Kolba and Melkasa 1 varieties.

Table 3. *Minerals content of maize varieties selected from deferent research center.*

S. No	Maize varieties	Ash (%)	Na (ppm)	Ca (ppm)	K (ppm)	P (ppm)
1	Hora	0.86^{bcd}	228.75^{e}	235.35^{def}	1849.95^{e}	1321.53^{abc}
2	Huluka	0.94^{ab}	269.48^{bc}	249.52^{cde}	2425.36^{c}	1372.06^{ab}
3	Jibat	1.12^{a}	279.29^{abc}	229.42^{def}	2088.17^{d}	1280.06^{bcd}
4	Kolba	1.12^{a}	249.53^{cde}	216.20^{f}	1646.68^{f}	1301.32^{abc}
5	Kulani	0.89^{bc}	268.81^{bc}	225.65^{ef}	1626.34^{f}	956.95^{e}
6	Melkasa 1	1.12^{a}	255.43^{cde}	248.82^{cde}	2096.64^{d}	1383.75^{ab}
7	Melkasa 2	0.64^{d}	286.46^{ab}	266.47^{bc}	2155.09^{d}	1026.82^{de}
8	Melkasa 4	0.70^{cd}	259.23^{bcd}	292.42^{b}	2598.75^{b}	1452.86^{a}
9	Melkasa 6Q	0.77^{bcd}	255.82^{cde}	332.34^{a}	2714.51^{a}	1230.21^{bcd}
10	Melkasa 7	0.83^{bcd}	302.33^{a}	245.82^{cde}	2179.15^{d}	1305.24^{abc}
11	Melkasa IQ	0.79^{bcd}	262.48^{bcd}	255.84^{cd}	2113.25^{d}	1350.43^{ab}
12	Wabi	0.97^{ab}	232.60^{de}	255.81^{cd}	2677.66^{ab}	1139.65^{cde}
Mean		0.89	262.52	254.47	2180.96	1260.07
LSD (α=0.05)		***	30.13	28.33	112.33	206.97
CV		14.52	6.78	6.58	3.04	9.70

Note: In each column means followed by different letters (a, b, c, d, e, etc.) are significantly different at p< 0.05.

Ikram (14) reported between 0.7% to 1.3% values of ash contents for ten maize varieties and it is in agreement with this study. The mean concentration of sodium (Na), calcium (Ca), potassium (K) and phosphorus (P) minerals ranges were 228.75 – 302.33 ppm, 216.20 – 332.34 ppm, 1626.34 – 2714.51 ppm and 956.95 – 1452.86 ppm respectively. Melkasa 6Q had the highest Ca and K while Kolba contained the least when compared to other varieties. Melkasa 7 and Melkasa 4 has superior Na and P contents respectively when compared to other maize varieties. Among determined minerals in maize varieties potassium consists of the highest ratio when compared to other minerals.

Therefore, the difference observed in physic-chemicals among maize varieties might be due to different genotypes and environmental conditions.

3.3. Characteristics of the Participants for Sensory Evaluation

Forty and twenty consumers participated in evaluate sensory attributes of maize porridge and Injera respectively.

Out of the 58 respondents who undertook the sensory evaluation, 23 female and 35 were male.

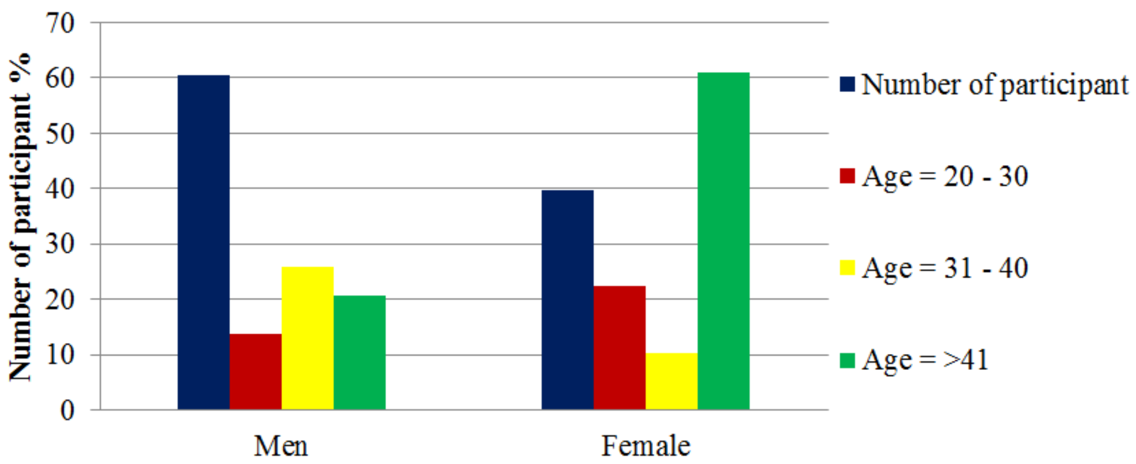

Figure 1. *Characteristics of participants for sensory evaluation.*

Table 4. *Maize porridge quality attributes score for selected food maize varieties.*

S.N	Maize Varieties	Porridge Sensory Attributes				
		Color ±SD	**Texture ±SD**	**Taste ±SD**	**Odor±SD**	**Overall accept. ±SD**
1	BH 661	7.35±2.23^{a}	6.83±1.17^{ab}	6.20±1.57^{abc}	5.43±2.42^{c}	7.08±1.01^{abc}
2	BH 540	6.80±1.79^{abcd}	7.30±2.08^{a}	6.60±1.85^{a}	5.93±2.28^{bc}	7.23±1.55^{ab}
3	Hora	6.48±1.72^{cde}	6.30±1.84^{cdfg}	6.23±2.06^{ab}	5.78±2.08^{bc}	6.33±1.57^{cde}
4	Huluka	7.03±2.01^{abcd}	6.43±1.78^{cbdef}	6.33±2.10^{a}	6.18±1.79^{abc}	6.65±2.01^{abcd}
5	Jibat	7.30±2.75^{ab}	6.48±2.43^{bacde}	6.15±2.30^{abc}	6.05±2.36^{abc}	6.65±2.16^{abcd}
6	Kolba	6.58±2.16^{abcde}	5.90±1.93^{efg}	6.18±2.33^{abc}	5.55±2.09^{c}	6.23±1.91^{def}
7	Kulani	6.55±2.45^{bcde}	6.53±2.10^{abcde}	5.98±2.46^{abcd}	6.08±1.89^{abc}	6.60±2.26^{abcde}
8	Limu	6.83±2.00^{abcd}	6.78±1.97^{abc}	6.60±2.45^{a}	6.83±2.46^{a}	7.30±2.09^{a}
9	Melkasa 1	6.98±2.26^{abcd}	6.33±2.08^{bcdef}	6.25±1.98^{ab}	6.10±2.19^{abc}	6.50±1.81^{bcde}
10	Melkasa 4	7.25±2.35^{abc}	6.73±2.60^{abcd}	5.85±2.42^{abcd}	5.90±2.55^{bc}	6.35±2.03^{cde}
11	Melkasa 2	6.38±2.10^{de}	5.70±2.18^{fgh}	5.43±2.20^{cde}	5.60±2.31^{c}	6.33±1.94^{cde}
12	Melkasa 1Q	6.38±2.55^{de}	5.33±2.30^{gh}	4.93±2.06^{e}	5.58±2.32^{c}	5.55±1.88^{f}
13	Melkasa 6Q	5.50±1.92^{f}	5.35±2.13^{gh}	5.53±2.02^{bcde}	5.73±1.91^{bc}	5.88±1.69^{ef}

S.N	Maize Varieties	Porridge Sensory Attributes				
		Color ±SD	Texture ±SD	Taste ±SD	Odor±SD	Overall accept. ±SD
14	Melkasa 7	6.40±2.24[de]	4.98±2.47[h]	5.20±2.11[de]	5.78±2.13[bc]	5.55±2.08[f]
15	Wabi	6.00±2.93[ef]	5.98±2.44[defg]	6.20±2.29[abc]	6.50±1.69[ab]	6.63±2.37[abcde]
Mean		6.64	6.18	5.98	5.93	6.43
CV		26.62	29.42	29.93	30.10	27.38
LSD (p<0.05)		0.08	0.80	0.79	0.78	0.77

Note: In each column means followed by different letters (a, b, c, d, e, etc.) are significantly different at α< 0.05. Where, 1=Dislike extremely, 2= Dislike very much, 3= Dislike moderately, 4=Dislike slightly, 5=neither like nor dislike, 6=Like slightly, 7=Like moderately. 8= Like very much and 9= Like very extremely

Table 5. Maize Injera quality attributes score for selected food maize varieties.

SN	Maize Variety	*Injera* Sensory Attributes					
		Gas hole distribution	Color	Texture	Taste	Odor	Over all accepta-bility
1	BH540	6.67±1.83[bc]	6.94±1.81[ba]	6.83±1.50[ba]	6.56±1.40[bac]	6.72±1.53[ba]	6.78±1.42[bac]
2	BH661	7.06±2.20[ba]	6.89±2.11[ba]	6.94±1.98[ba]	6.89±2.05[ba]	6.50±2.01[bac]	7.11±2.09[a]
3	Hora	7.06±2.03[ba]	6.83±1.50[bac]	6.89±1.89[ba]	6.17±1.83[dec]	6.28±1.75[ebdac]	6.50±1.38[bdac]
4	Huluka	7.06±2.15[ba]	7.22±2.43[a]	6.33±2.12[bc]	5.89±1.98[fdec]	6.39±2.13[bdac]	6.89±1.80[bac]
5	Jibat	4.94±1.51[d]	6.00±1.54[bdc]	5.72±1.64[dc]	5.72±1.76[fdeg]	5.61±1.78[egdf]	6.06±1.76[de]
6	Kolba	6.83±1.37[bac]	7.28±1.66[a]	5.94±1.58[dc]	6.06±1.42[dec]	6.61±1.68[bac]	6.50±1.41[bdac]
7	Kulani	6.33±1.47[bc]	6.78±1.60[bac]	5.83±1.43[dc]	6.39±1.51[bdac]	6.00±1.72[ebdc]	6.72±1.50[bdac]
8	Limu	7.72±2.21[a]	7.50±2.30[a]	7.28±1.99[a]	7.06±1.60[a]	6.89±1.88[a]	6.94±1.59[ba]
9	Melkasa 6Q	6.83±1.73[bac]	7.06±1.40[a]	6.17±1.71[bc]	5.89±1.68[fdec]	6.33±1.42[bdac]	6.28±1.41[bdc]
10	Melkasa 1	3.83±1.71[e]	4.39±1.73[f]	4.61±1.64[f]	4.94±1.71[h]	4.78±1.89[h]	5.06±1.76[f]
11	Melkasa 2	6.06±1.47[c]	5.89±1.35[edc]	5.83±1.42[dc]	6.22±1.68[bdec]	6.33±1.68[bdac]	6.50±1.36[bdac]
12	Melkasa 7	4.72±1.67[ed]	5.22±1.15[edf]	5.28±0.96[dfe]	5.11±1.16[hg]	5.50±1.45[egfh]	5.44±1.39[fe]
13	Melkasa IQ	4.39±2.19[ed]	5.00±2.11[ef]	5.17±2.20[dfe]	5.06±1.78[hg]	5.00±1.53[gh]	5.17±1.59[f]
14	Melkasa 4	4.17±1.85[ed]	4.89±1.55[f]	4.83±1.47[fe]	5.22±1.58[fhg]	5.17±1.36[gfh]	5.33±1.86[f]
15	Wabi	4.89±1.51[d]	5.33±1.49[edf]	5.56±0.94[dce]	5.67±1.53[feg]	5.89±1.50[edfc]	6.22±1.23[dc]
Mean		5.90	6.21	5.95	5.92	6.00	6.23
CV		23.93	23.38	21.58	17.30	20.44	17.31
LSD (p<0.05)		0.93***	0.95***	0.84***	0.67***	0.81***	0.71***

Note: In each column means followed by different letters (a, b, c, d, e, etc.) are significantly different at α < 0.05. Where, 1=Dislike extremely, 2= Dislike very much, 3= Dislike moderately, 4=Dislike slightly, 5=neither like nor dislike, 6=Like slightly, 7=Like moderately. 8= Like very much and 9= Like very extremely.

All accessed sensory quality attributes were strongly significant ($p < 0.05$) among maize varieties. The perceptions of sensory attributes may be defined as the evaluated adequacy of the product in terms of its set of desirable eating quality characteristics like appearance, taste, aroma and texture [15]. The sensory characteristics of a food play a significant role in the acceptance of a food product. The physical and chemical composition of food is perceived by an individual as sensory attributes such as appearance, aroma, texture and taste [16]. Therefore, chemical compounds in the food such as the amount of protein or carbohydrates a food contains may affect a consumer's acceptance of the product [17].

Table 6. Correlation coefficients of maize porridge sensory attributes with physicochemical quality of maize varieties.

Variable	Col	Textur	Taste	Odor	OAA	TKW	MC	Oil	Protein	Starch
Color	1.00	0.62***	0.51***	0.42***	0.36***	0.02	-0.05	0.02	-0.17	0.15
Texture		1.00	0.56***	0.48***	0.50***	0.12	-0.03	0.10	-0.24	0.17
Taste			1.00	0.61***	0.58***	0.07	-0.07	0.06	-0.20	0.10
Odor				1.00	0.55***	-0.07	-0.01	-0.02	-0.08	-0.03
OAA					1.00	0.05	0.00	0.20	-0.05	-0.03
TKW						1.00	0.17	0.72***	-0.63***	0.58***
MC							1.00	0.43***	0.21	0.62***
Oil								1.00	-0.32	0.50**
Protein									1.00	-0.55***
Starch										1.00

Where, SD=standard deviation, ***=P<0.0001 and **=P<0.005

All sensory attributes were positively correlated to each other and strongly significant (P<0.0001). The quality attributes of all maize porridges were also positively correlated to each other and strongly significant (P<0.0001). Thousand kernel weight was positively correlated to oil and starch contents but negatively correlated to protein content and strongly significant (P<0.0001). Moisture content was positively correlated to oil and starch contents and highly significant (P<0.0001). Protein content was negatively correlated to thousand kernel weight and starch contents and strongly significant (P<0.0001). Oil composition was positively correlated to starch content and has significant (P<0.0005) differences. Moisture content was positively correlated to oil and starch contents and highly significant (P<0.0001).

4. Conclusion and Recommendations

There is significant (P<0.05) variation in physical, chemical and organoleptic properties due to test genotypes. All varieties had an acceptable range of physical and chemical composition. The result obtained shows that maize contains high starch, quite protein, oil and minerals content. The overall acceptability of food products prepared from maize varieties varies from dislike moderately to like moderately. The result also indicates varieties with higher starch content and white color (BH540, BH661 and Limu) got better acceptance value than those varieties with higher protein content and yellow color (Melkasa 1, Melkasa seven, Melkasa IQ) except Melkasa 6Q by panelists. Melkasa 6Q has white color and the highest protein content among tested genotypes and neither liked nor disliked for Injera but slightly liked for porridge. Regarding future variety verification trail, we would like to recommend that physiochemical and consumers' preference evaluation in the same environment and crop management should be included.

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Author Contributions

Megersa Daba: Conceptualization, Data curation, Formal Analysis, Writing – original draft, Writing – review & editing

Abiyot Lelisa: Methodology, Project administration, Supervision, Validation, Visualization

Conflicts of Interest

The authors declare no conflicts of interest.

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