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Proximate Composition Analysis of Different Maize Varieties Adapted Under Somali Region Pastoral and Agro-Pastoral Research Institute (Sorpari) Ethiopia.

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ABSTRACT

The study was conducted in Somali Regional state with objective to analyze macronutrient and mineral content of different maize varieties adapted under Somali Region pastoral and Agro-pastoral research institute (SoRPARI). Four different types of samples such as Melkasa-6Q, MH-138, BH661 and BH-549 sample were collected. The collected maize samples were individually grounded to a fine powder (30 mesh size), packed in air tight polyethylene plastic bags and were stored at 4°C until further analysis. Proximate composition such as crude Protein, crude Fat, crude fiber, moisture content, carbohydrate, different minerals like Calcium, Iron, zinc and total phosphorous were determined by AOAC. Based on the result obtained, the ash content of the four maize varieties is in the range 4.06(Bh-549)-5.88% (Melksa-6Q), while the protein content from 12.82 (BH-549)-15.24% (Melkasa-6Q). The fat content is in the range 11.89 (BH661)-31.61%(Melkasa-6Q) while the carbohydrate content is in the range of 34% (Melkasa-6Q)-59.07% (BH-549). Significant difference was observed in most of these macronutrient content at $p<0.05$. Significant difference was also observed at $p<0.05$ in minerals content such as Calcium, Zinc, iron and Total Phosphorous where Melkasa-6Q had highest in almost all minerals content. Overall, from the finding we conclude that, all adapted maize varieties have good in both macronutrient and minerals especially Melkasa-6Q. Therefore, all actors of maize should contribute to the promotion of nutrient dense varieties of maize to the local community which in turn important for the fight against malnutrition.

Key Words: Maize, maize varieties, macronutrient, mineral content.

1. Introduction

Maize belongs to Family Poaceae and Genus Zea. By origin, it is a tropical crop and has adapted magnificently to temperate environments with much higher productivity. It is grown from latitude 580 N to 400 S, from sea level to higher than 3000 m altitude and in areas receiving yearly rainfall of 250 to 5000 mm (Dowswell, 2019; Premlatha and Kalamani, 2010). Major maize producers are the USA (30%), China (15%), European Union (14%), Brazil (4%) and India (3%). These five countries have around 60% of the world's corn harvested area (Annonymous, 2007; Ye et al., 2015).

In sub-Saharan Africa, maize is a staple food for an estimated 50% of the population and it remains the most important agricultural crop for over 70 million farm families worldwide. Of the 22 countries in the world where maize forms the highest percentage of energy in the national diet, 16 are in Africa (Nuss and Tanumihardjo, 2011). Ethiopia is among the major maize producers in Africa and ranked third next to South Africa and Nigeria (Faostat, 2012). Maize production takes significant share of cereals and grain in any production year. Among cereals, maize ranked second to tef in area coverage (21.7% for maize and 27.4% for tef), and first in total production (28.5% for maize and 19.9% for tef) and productivity (Mosisa et al., 2011).

Maize is used as a basic food ingredient, either in its original or modified form. Maize grains are a rich source of starch (72%), ash (17%), protein (10.4%), fiber (2.5%), oil (4.8%), vitamins and minerals (Farhad et al., 2009; Tian ZhiQiang et al., 2018). The oil and protein contents have commercial value and are used in food products manufacturing (Paliwal et al., 2000). Maize is used primarily as a food for humans in most areas of the world, in contrast to the United States where about 85 percent of the crop is used as cattle feed. Byproducts of processing are gluten

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feed, gluten meal, oil cake meal, germ meal, distiller's and brewer's grains.

Maize is used as human food in the form of tortillas, porridge, popcorn and barbecues and as forage and silage for animals. It is also a good source of industrial products such as starch (Zhang et al., 2012), vitamin (Warman and Havard, 1998), fiber, oil, weaning porridges (Mburu et al., 2012) and ethanol (Lamsal et al., 2011). Yellow maize, in addition to being dietary source of energy, lipids, protein, minerals and vitamins, it is a source of carotenoids (Adom and Liu, 2002; Menkir et al., 2008). Food composition data is important in nutritional planning and provides data for epidemiological studies (Ali et al., 2008). However, there is no or limited study about the nutritional content of the different maize varieties growing in Ethiopia particularly in Somali region. This study is designed to provide information on macronutrient and mineral composition of different maize varieties adapted under Somali region pastoral and agro-pastoral research institute (SoRPARI) Somali Region in Ethiopia.

2. Materials and Methods

2.1. Materials and Equipment Used

Four different maize varieties produced/adapted under SoRPARI were collected from Kelafo agricultural research sub center. The four varieties collected were BH661, BH-549, Melkasa 6 Q and MH 138. Maize samples were individually ground to a fine powder (30 mesh size), packed in air tight polyethylene plastic bags and were stored at 4°C until further analysis.

2.2. Proximate Composition

The proximate composition of maize flours was determined using the standard AOAC methods (Ac, 2000). Moisture content was done by the gravimetric method in a hot air oven at 105 ºC until constant weight, and the quantity of ash was analyzed using a muffle furnace at 550 ºC. Crude protein content was measured by a standard Kjeldahl method using 5.95 as the conversion factor. Flour lipids were analyzed by the solvent extraction procedure. The content of total carbohydrates was determined by difference from the analysis of moisture, ash, protein and lipids. Whereas, gross energy was determined by calculation from fat, carbohydrate and protein contents using the Atwater's conversion factors: 16.7 KJ/g (4 kcal/g) for protein, 37.4 KJ/g (9 kcal/g) for fat and 16.7 KJ/g (4 kcal/g) for carbohydrates and expressed in calories (Ac, 2000).

2.3. Mineral analysis

The mineral contents were determined by the procedure of(Ac, 1984) . Calcium, iron, and zinc were determined according to (Ac, 2000) official methods of 985.35 using an Atomic Absorption Spectrophotometer while phosphorous was determined by official method of 986.24 using calorimetric method using ammonium molybdate.

2.4. Statistical analysis

All the analysis was performed in duplicate (unless stated otherwise) and presented as mean ± standard deviation. Statistical significance of the data obtained was analyzed by One-way analysis of variance (ANOVA) followed by Duncan test by using Genstat version 18.0. The level of significance was considered at $P < 0.05$.

3. Results and Discussion

3.1. Macronutrient content

The macronutrient content of different maize varieties has been indicated in table 1. As indicated, the moisture content significantly different among different maize varieties at $p<0.05$. The variation of moisture contents in maize flours may be attributed by different factors such as agronomic, environmental factors and the maize variety. The result in moisture content is in agreement with research done on seven different maize varieties by (Demeke, 2018) with is in between 9.42-11.45%. It is inconsistent with research done by (Uday Kumar, 2014) which is in between 4.3 to 6.7%. On the other hand, the result of moisture content indicates all maize are in very good range for their shelf stability.

As shown in table 1, all maize varieties have high amount ash. The ash content beyond normal values of most common maize varieties of anywhere. This indicates all maize varieties have good source of different minerals. The ash content is a little bit different in amount among the four varieties and some are significantly different at $P<0.05$. This might be the fact that, there are different in variety, there response against different harsh condition might be different, the way they are managed during their farming time and some other reasons. Ash content of BH661, BH-549 and MH-138 maize flour was also in relatively good agreement with the literature 1.4–3.3% (Qamar et al., 2017), whereas it is higher in melkasa -6Q maize. All maize ash content is inconsistent with result obtained by (Demeke, 2018) which is in between 1.37 to 1.74%. The difference might be due being in different agro ecology, different farming system and environmental factors.

Fiber has beneficial effects on diabetes, atherosclerosis, cancer, and appendicitis and prevention of duodenal ulcer formation and varicose veins (Yeung, D. L. and Laquatra I, 2003). The fiber of different maize varieties under this study shows some significantly different at $P<0.05$ as shown in table 4.1. This might be due being different in variety, the resistance against different environmental factors. The result crude fiber content is in agreement with the research done by (Demeke, 2018) which are in the range of 1.62 to 3.46%.

Protein is the building block of all cells. All maize varieties have highest in protein content especially Melkasa-6Q which 15.24% as shown in table 1. But there is Significant difference among maize varieties under study at $P<0.05$. This might be the fact that, because of being different in their variety, their difference in their resistance and utility of naturally occurring nutrient, soil difference. The result of protein content is in agreement with the research done

Table 1: Proximate composition of different Maize Varieties

Varieties	Results in (%)/(100g)						
	Moisture	Ash	C.Fiber	C.Protein	C.Fat	CHO	Energy
BH661	$10.68\diagup0.00^{c}$	$4.07\diagup0.00^{a}$	$3.11\diagup0.11^{c}$	$13.49\diagup0.80^{a}$	$11.89\diagup0.38^{a}$	$56.77\diagup1.26^{b}$	$400.5\diagup1.96^{a}$
BH-549	$10.00\diagup0.02^{a}$	$4.06\diagup0.02^{a}$	$1.85\diagup0.04^{b}$	$12.82\diagup0.23^{ab}$	$12.20\diagup0.29^{a}$	$59.07\diagup0.01^{b}$	$404.7\diagup1.51^{a}$
MH-138	$10.36\diagup0.015^{b}$	$4.74\diagup0.22^{a}$	$1.77\diagup0.11^{b}$	$14.57\diagup0.23^{ab}$	$11.96\diagup0.11^{a}$	$56.60\diagup0.21^{b}$	$399.5\diagup1.45^{a}$
Melkasa-6Q	$10.94\diagup0.035^{d}$	$5.88\diagup0.37^{b}$	$1.44\diagup0.015^{a}$	$15.24 + -0.21^{b}$	$31.61\diagup1.04^{b}$	$34.89\diagup2.20^{a}$	$490.8\diagup3.86^{b}$

Key: Same letter in the same column is not significantly different from each other at p<0.05 CHO: Carbohydrate, Energy: Energy in Calory unit obtained from consuming 100g of these maize varieties

Table 2: Mineral's content of different Maize varieties

Maize varienties	Result in (mg/Kg)			
	Calcium (Ca)	**Zink (Zn)**	**Iron (Fe)**	**Total phosphorous (TP)**
BH661	670.7 ± 41.54^{a}	59.62 ± 1.59^{a}	135.1 ± 7.85^{a}	669.9 ± 21.38^{a}
BH-549	852.6 ± 53.32^{b}	61.84 ± 1.22^{a}	129.4 ± 6.6^{a}	759.7 ± 11.98^{a}
MH-138	1068.3 ± 2.31^{c}	66.84 ± 3.43^{a}	150.6 ± 6.49^{ab}	976.5 ± 19.82^{b}
Melkasa-6Q	1001.0 ± 31.84^{c}	85.42 ± 0.31^{b}	186.9 ± 12.7^{b}	901.4 ± 26.59^{b}

Key: Same letter in the same column is not significantly different from each other at p<0.05

by (Demeke, 2018) on seven different varieties which are in the range of 9.69 to 15.30%. In a similar fashion, the present study range of crude protein contents were within the range reported by (Fageer and El Tinay, 2004) for twelve genotype 11.3 to 16.9% and (Ullah et al., 2010) for 10 varieties 7.7 to 14.6%. Fat is one the macronutrient which provide more than twice of energy than carbohydrate and protein. Exceptionally, melkasa-6Q has the highest crude fat content than any other maize varieties under study as shown in table 4.1. This might be the fact that, melkasa-6Q is one the new varieties released for its high in protein and some other useful nutrient content in fighting malnutrition. The result obtained is inconsistent with the research done on seven different maize varieties by (Demeke, 2018) which are in the range of 5.13 to 7.22%.

Carbohydrate is one the macronutrient which provide energy. The carbohydrate content of three maize varieties (BH661, BH-549, MH-138) are under normal range. But there is Significant difference at p<0.05 in carbohydrate content when it comes to Melkasa-6Q as shown in table 1. This difference mainly come as result of melkasa -6Q has high amount fat content. And it is also the fact that being different variety, their response against different environmental factors. The result obtained is inconsistent with the research done on seven different maize varieties by (Demeke, 2018) which are in the range of 67.10 to 69.99%.

Energy is obtained from the main macronutrients such as carbohydrate, protein and fat. There is no significant difference at P<0.05 in energy between all maize varieties except melkasa-6Q as shown in table 1 above. But there is a little difference in energy content among the three maize varieties under study except Melkasa-6Q. This is because of their difference in protein, carbohydrate and fat content. The result obtained is a little bit different from the research done by (Ullah et al., 2010) on ten different maize varieties which are in the range of 365.95 to 385.83Kcal/100g.

3.2. Mineral content of maize

Minerals are essential for body functions. The calcium content is in the range of 670.7 to 1068.3mg/Kg as shown in table 2 above. Except MH-138 and Melkasa-6Q there is significant difference in calcium content at P<0.05 among the maize varieties under study at p<0.05. This might be due to difference in variety, environmental factors, their utilities toward minerals in the soil. The result obtained is in contradict with the research done in Ethiopia by (Demeke, 2018) on seven maize varieties which are in the range of 219.8 to 481.0mg/Kg and it also inconsistent with result of (Qamar et al., 2017) done in Pakistan which are in the range of 1290.27 to 1327.56mg/Kg. This difference may be due to being in different agro-ecology, different farm management system, virginity of soil and some other reasons.

When it comes Zinc, the values are in the range of 59.62 to 85.42mg/Kg. There is no significant difference in zinc content except Melkasa-6Q at P<0.05 as shown in table 2. This little difference come as result of being difference in variety, their response against different harsh condition, soil types. The result obtained is in contradict with the research done in Ethiopia by (Demeke, 2018) on seven maize varieties which are in the range of 23.1 to 29.3mg/Kg and it also inconsistent with result of (Qamar et al., 2017) done in Pakistan which are in the range of 6.1 to 33.89mg/Kg. This difference may be due to being in different agro-ecology, different farm management system, virginity of soil and some other reasons.

The iron (Fe) content of different maize varieties under study is in the range of 129.4-186.9mg/Kg. There is some significance difference among maize varieties under study as shown in table 2 above. This is because of being different in their variety type, utility of minerals with in a soil, difference in soil minerals continent. The result obtained is in contradict with the research done in Ethiopia by (Demeke, 2018) on seven maize varieties which are in the range of 23.4 to 37.3mg/Kg and it also inconsistent with result of (Qamar et al., 2017) done in Pakistan which are in the range of 80.73 to 115.13mg/Kg. This difference may be due to being in different agro-ecology, different farm management system, virginity of soil and some other reasons. Finally, the total phosphorous content of the four maize under study is in the range of 669.9 to 976.5mg/Kg. There is some significant

difference among maize varieties under study as shown in table 4.2 above. This difference come as a result of being different in variety, soil mineral content, their utility toward this mineral.

4. Conclusion

From the result we conclude that, all maize verities have high macronutrients and minerals content especially melkassa-6Q. The high in protein and ash content is most important in fighting malnutrition especially the hidden hunger if these maize varieties are mixed with nutrient dense legumes and nuts or fortified with different supplements. The high in minerals content is an indication that our region soil is rich of minerals and virgin. Therefore, we recommend all stakeholders to work in collaboration to provide stress resistant, nutrient dense maize varieties to the community in ensuring food security.

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Conflict of Interest

Authors declare that there is no conflict of interests involve in publishing this research paper.

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