Physico Chemical properties in Relation to Bread Making Quality of Ethiopian Improved Bread Wheat (Triticum astivum L) Cultivores Grown at Kulumsa, Arsi, Ethiopia

Soboka S1, Bultossa G2 and Eticha F3
1Oromia Agricultural Research Institute, Food Science Directorate, Addis Ababa, Ethiopia
2Botswana College of Agriculture, Content Farm, Sebele, Gaborone, Botswana
3Ethiopian Agricultural Research Institute, Kulumsa Agricultural Research Center, Ethiopia

Abstract

Many food processing industries utilizing bread wheat as a raw material are being established in the country. As a result, information on physico-chemical characteristics to match intended end use quality is very essential. In line with this, this study was initiated with objectives to characterize the physico-chemical properties in relation to bread making quality and to classify bread wheat cultivars considered as soft and hard wheat based on quality traits characterized. The grain of 23 bread wheat cultivars was collected from Kulumsa Agricultural Research Center from harvest of 2011/12 cropping season and analyzed for grain physical and flour chemical quality characteristics. Significant variations in all parameters considered were observed among the cultivars except hectoliter weight (HLW). Thousand kernel weight (TKW), percent vitreous kernel (%Vk), average kernel size and particle size index (% PSI) were shown high significant difference (P<0.01) due to bread wheat genotypes. Mada Walabu got largest grain size, TKW and larger percentage PSI. Kakaba, Simba, Tay, Pavon 76, and Gassay were genotypes with superior protein quantity while Simba, Sirbo, Kakaba and Pavon 76 were those having higher wet gluten (WG), dry gluten (DG) and gluten water absorption (GWA). Cultivars with lower % PSI got higher WAB.

Keywords: Bread wheat; Grain hardness; Vitreousness

Introduction

Wheat is one of the most important cereal crops of the world and is a staple food for one third of the world's population [1]. In Ethiopia, wheat ranks fourth after Maize (Zea mays) Sorghum (Sorghum bicolor) and Teff in area coverage and second in total production and productivity after maize and Ethiopia is the largest producer of wheat in sub-Saharan Africa where wheat occupies about 1.8 million hectares annually [2], where, 75.5% of the current total wheat production area is located in Bale, Arsi and Shewa highlands.

The economic value of wheat is mainly determined by the class, which in part depends on morphology, texture and composition of the grain. Grain morphology and texture are important quality traits because they influence grain end use quality and market value of wheat as it is an expression of grain composition. Physico-chemical properties of grain have a direct or indirect influence on the milling and baking qualities of wheat which mainly depends on genetic variation of the crop. The requirements of wheat grain quality are different for the major baked products such as bread, pastries and cookies and also within each of the types, are based on grain physical, flour chemical and dough rheological properties [3]. Grain appearance score, hardness and vitreousness of kernel, test weight; kernel size and shape of the kernel are some physical characters which are indirect descriptors of wheat chemical (protein quality and quality) composition and influence the final product.

In Ethiopian wheat improvement research since its inception prior to 1930’s has focused on improving grain yield and disease resistance. With the emerging and increase of food processing industries using wheat as a raw material, industrial quality of wheat has become important. Quality reports in relation to bread making quality are available for only few of the wheat cultivars released so far [4-6]. On the other hand, information on physico-chemical quality parameters is necessary to assess the suitability of wheat cultivars for different industrial products. With this justification, this work was initiated with the objectives to characterize physico-chemical properties of some released bread wheat cultivars and classify cultivars considered as soft and hard bread wheat on the bases qualities characterized.

Materials and Methods

Description of the study area and experimental materials

The grain of 23 wheat varieties (Table 1) was collected from Kulumsa Agricultural Research Center (KARC) from field activity carried out during the 2011/12 main cropping season (July-Nov 2011/12). Kulumsa Agricultural Research Center is located in Arsi Zone of Oromia Regional State of Ethiopia and lies at an altitude of 2200 masl., 8°10’N latitude, 39°10’E longitude, representing a medium altitude and moderate rainfall (830 mm/annum).

Experimental design and laboratory analysis

The laboratory experiment was arranged in a single factor factorial completely randomized design (CRD) with three replications. Laboratory analysis was carried out at Haramaya University Food Science and Postharvest Technology laboratory and Sinana Agricultural Research Center Grain Quality laboratory.

Grain physical quality parameters

Cleaned grain was taken for the measurement of 1000 grain weight

*Corresponding author: Shure Soboka, Oromia Agricultural Research Institute, Food Science Directorate, Addis Ababa, Ethiopia, Tel: +251-911071871; E-mail: ibsasoboka2020@gmail.com

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Vitreousness: (VK) was determined following ICC standard number 129 [8] and fitted at zero and made pass through 75 µm standard sieve and a standard hardness mill perten 3303 revolving at 3500 ± 100 rpm. Grain hardness index (PI) according to AACC method 55-31 [7] using free basis using laboratory standard hectoliter and electronic balance determined according to AACC method 08-01 [7].

Iodine binding to amylase according to AACC [7] and Ash content was determined according to AACC Method 56-70 [7], and dry gluten was determined according to AACC Method 38-10 [7], whole meal by micro-Kjeldehal method as described in AACC method 20-01. Thousand kernel weights (TKW) using Chopin grain counter model-NMU 2, hectloitter weight (HLW) varied from the smallest 27.23 g (Sofumer) to the largest 43.36 g for (Mada Walabu) and significantly different (P<0.05) among tested genotypes. Most (65.22%) of the wheat cultivars got TKW which fall between 30 g and 40 g, 30.43% of them have TKW less than 30 g and the rest (Mada Walabu) 4.35% have TKW greater than 40 g, Mada Walabu got significantly the largest TKW followed by Dinkineshe, Galil and Enseno having value (43.36, 37.39, 37.00, and 36.71 g) respectively. The lowest TKW was obtained for bread wheat variety Sofumar followed by Kakaba, Sirbo and Kbg-01 which are statistically at par.

Ermias [5] and Solomon et al. [4] stated that the TKW values of 20 advanced bread wheat lines grown at Haramaya and ten Ethiopian bread wheat cultivars grown at Kulumsa fall in the range 33.2-44.8 g. 32.0-45.9 g respectively which are the same range to the results of present study. In some previous studies it was showed that genotype has significant effect on variability in TKW as to the results in the current study. Thousand kernel weights are an important indication of flour yield where wheat can be classified according to grain weight as 15-25 g (very small), 26-35 g (small), 36-45 g (medium), 46-55 g (large) and over 55 g (very large) [9]. Accordingly, 82.6% of the wheat cultivars in the current study fall under small grain category while the rest 17.4% of the cultivars in medium sized kernels. It is obvious that wheat varieties Madawalabu, Dinkineshe, Galil and Gassay possessing relatively higher TKW >35 g can be explored by different stakeholders for improvement in grain yield and better flour extraction during milling.

Hectoliter weight (HLW): Hectoliter weight (HLW) varied from the smallest 77.69 (Hawi) to the largest 82.50 kg/hL (Digalu). Most of the cultivars showed no significant differences (P>0.05) in their HLW except between the highest (Digalu and Enseno) and the lowest (Hawi and Pavon 76). The result showed, 65.22% of wheat cultivars used for this study has HLW above 80 kg/hL while the rest between 77 and 80 kg/hL.

The hectoliter weight, which is dependent on both grain size and shape is considered to be one of the important physical criteria in all wheat grading systems as it highly influence flour yield and other quality parameters. The results obtained in this experiment were in close agreement to reports by Cornish et al. [10] and Walle [11] who reported that HLW of 130 hard red spring bread wheat grown at different locations of USA varied from 66.2 to 80.20 kg/hL and 77.91 kg/hL to 82.15 kg/hL in 20 bread wheat cultivars of Ethiopia, respectively. It is also in consistent with the findings of other researchers Muhammad et al. [12] who reported variations from 68.30 to 81.00 kg/hL in different Pakistani wheat varieties.

Vitreousness: The vitreousness kernel values of wheat cultivars under this study (Table 2) ranged from 9.40 to 95.27%. The highest %VK was observed for cultivars Simba, Pavon 76 and Sofumer while the lowest values were for Dodota and Aldoro. Vitreousness values have shown high significant (P<0.01) difference among the bread wheat cultivars. In this study 56.52% had %VK value above 70%, 17.40% of them between 60% and 70%, 17.40% of the test cultivars have %VK values between 30 and 60% and the rest cultivars (8.68%) less than 10.50%.

Higher %VK indicates higher protein content, a harder kernel, coarser granulation, during milling higher yield of flour, superior

**Table 1:** List of bread wheat cultivars used in quality analysis and their description.

| No. | Variety Name | Pedigree | Breeder | Year of Release |
|-----|--------------|----------|---------|-----------------|
| 1   | Aldoro       | HK-14-R251 | HARCEIAR | 2007            |
| 2   | Bolo         | HAR-3816  | DBARCARARI | 2009          |
| 3   | Danda’a      | Darhefi1  | KARCEIAR | 2010            |
| 4   | Digelo       | SHA 7/KAUZ or HAR 3116 | KARCEIAR | 2005            |
| 5   | Dinkineshe   | HAR-3919  | SRARCARARI | 2007          |
| 6   | Dodota       | HAR-2508  | KARCEIAR | 2001            |
| 7   | Galil        | Galil     | Hazera Genetics | 2010    |
| 8   | Gassay       | HAR-3730  | ADARCARARI | 2007          |
| 9   | Hawi         | HAR-2501  | KARCEIAR | 1999/0          |
| 10  | Enseno-1     | BWRAW03/36 | AwARCARASI | 2009          |
| 11  | Kakaba       | Picaflor # 1 | KARCEIAR | 2010          |
| 12  | Kata         | HAR-1899  | KARCEIAR | 1998/9         |
| 13  | Kbg-01       | FH-1-7A or Line 8.3.8 | KARCEIAR | 2001          |
| 14  | Kubsa        | HAR-1685  | KARCEIAR | 1995            |
| 15  | Madda       | HAR-1480  | SARC/OARI | 1999/0        |
| 16  | Millennium   | ETBW-4921 | KARCEIAR | 2007            |
| 17  | Pavon-76     | VCMICNQ017C/3/KALIBB | KARCEIAR | 1998/0        |
| 18  | Simba        | HAR-2536  | KARCEIAR | 2001            |
| 19  | Sirbo        | HAR-2192  | KARCEIAR | 2001            |
| 20  | Sofumer      | HAR-1889  | SARC/OARI | 1999/0       |
| 21  | Sula         | 710/RBC   | AwARCARASI | 2007          |
| 22  | Tay          | ET-12 D4/HAR 604 (1) | ADARCARARI | 2005          |
| 23  | Tossi        | HAR 3123  | KARCEIAR | 2004            |
Some wheat grain physical quality parameters.

| Variety   | TKW (12.5%) | TW (12.5%) | % MC | Virtuousness | %PSI |
|-----------|-------------|------------|------|--------------|------|
| Aidoro    | 32.67 ± 0.38 aa | 79.15 ± 1.37 aa | 9.17 ± 0.09 ab | 10.50 ± 1.32 ab | 35.10 ± 0.36 ab |
| Bolo      | 30.12 ± 1.31 a | 80.55 ± 4.45 a | 10.22 ± 0.51 ac | 35.63 ± 4.97 ac | 34.20 ± 0.46 ac |
| Danda'a   | 32.23 ± 0.56 ab | 80.96 ± 2.04 ab | 9.50 ± 0.23 bc | 79.10 ± 1.11 ef | 15.77 ± 0.21 de |
| Dinkesh   | 29.35 ± 0.21 bc | 82.50 ± 3.12 bc | 9.71 ± 0.10 bc | 69.23 ± 5.34 ef | 36.27 ± 2.18 b |
| Dinkesh   | 37.39 ± 0.51 a | 79.61 ± 4.10 a | 9.24 ± 0.19 bc | 83.93 ± 2.48 ef | 13.20 ± 0.69 ef |
| Dodota    | 31.78 ± 1.27 d | 79.30 ± 2.45 d | 9.56 ± 0.19 bc | 9.40 ± 0.46 bc | 25.87 ± 0.96 bc |
| Enseno    | 34.76 ± 0.74 c | 77.69 ± 1.20 c | 8.78 ± 0.19 bc | 84.87 ± 2.87 ef | 19.33 ± 0.95 ef |
| Gall     | 36.71 ± 0.56 b | 82.00 ± 2.65 b | 10.43 ± 0.29 bc | 68.40 ± 6.26 ef | 17.37 ± 0.81 ef |
| Gassay   | 37.00 ± 1.64 b | 80.16 ± 3.00 b | 10.73 ± 0.64 bc | 63.65 ± 1.36 ef | 13.97 ± 0.31 ef |
| Hawi     | 34.39 ± 0.73 b | 80.17 ± 1.15 b | 9.56 ± 0.19 bc | 70.30 ± 4.51 ef | 15.20 ± 0.50 ef |
| Kakaba   | 27.29 ± 0.32 c | 80.88 ± 1.93 c | 8.56 ± 0.19 bc | 77.07 ± 1.26 ef | 18.23 ± 0.51 b |
| Katar    | 30.99 ± 1.70 d | 81.02 ± 0.67 d | 10.00 ± 0.20 bc | 49.08 ± 1.82 ef | 17.83 ± 1.91 ef |
| Kbg-01   | 28.26 ± 0.32 c | 80.40 ± 2.01 c | 9.89 ± 0.19 bc | 54.60 ± 1.39 ef | 21.07 ± 1.10 ef |
| Kubsa    | 33.08 ± 0.55 c | 80.86 ± 0.98 c | 10.11 ± 0.19 bc | 63.37 ± 1.99 ef | 18.07 ± 0.21 ef |
| M. Walabu | 43.36 ± 0.48 b | 80.43 ± 0.66 b | 9.55 ± 0.16 ab | 74.47 ± 1.80 ef | 32.20 ± 0.95 ef |
| Millinum | 31.06 ± 0.70 a | 79.36 ± 1.30 a | 9.44 ± 0.51 b | 89.37 ± 3.24 ef | 25.50 ± 0.46 ef |
| Pavana   | 29.72 ± 0.18 c | 77.85 ± 2.62 c | 9.46 ± 0.18 bc | 95.10 ± 1.57 ef | 11.63 ± 0.13 c |
| Simba    | 32.09 ± 0.77 c | 81.34 ± 2.07 c | 9.57 ± 0.15 bc | 92.75 ± 0.57 ef | 11.27 ± 0.15 c |
| Sirbo    | 27.33 ± 0.52 c | 80.46 ± 3.02 c | 9.56 ± 0.19 bc | 90.11 ± 1.74 ef | 16.60 ± 0.56 ef |
| Sofumer  | 27.23 ± 0.57 c | 79.57 ± 3.49 c | 8.99 ± 0.11 bc | 92.70 ± 0.82 ef | 11.27 ± 0.21 c |
| Sula     | 31.24 ± 1.02 d | 80.10 ± 1.28 d | 9.77 ± 0.23 bc | 32.70 ± 0.10 ef | 17.60 ± 0.95 ef |
| Tay      | 33.21 ± 0.24 a | 81.30 ± 2.34 a | 9.81 ± 0.19 bc | 72.13 ± 1.23 ef | 36.33 ± 2.04 ef |
| Tossa    | 29.11 ± 0.49 bc | 79.49 ± 1.40 bc | 9.22 ± 0.19 bc | 88.60 ± 1.49 ef | 13.80 ± 0.17 ef |
| G. Mean  | 32.19 ± 3.86 c | 80.22 ± 2.27 c | 9.60 ± 0.54 c | 67.77 ± 24.53 ef | 20.52 ± 8.50 ef |
| LSD (0.05) | 1.32                | 3.93                | 0.44                | 3.84                | 5.11               |
| CV       | 2.50                | 3.98                | 2.79                | 3.46                | 5.72               |

Values with different letter within a column are significantly different (P<0.05) by LSD. P: Protein (%); TGW: Total Grain Weight; WG: Wet Gluten (%); D: Dry gluten (%); G: Gluten index (%); GWA: Gluten Water Absorption (%); SDS: Sodium Dodecyl Sulfate sedimentation in ml at 14% moisture bases; CV: Coefficient of Variation; LSD: Least Significant Difference. Values are mean ± standard deviation.

Grain chemical quality parameters

Protein content: There was significance differences (P<0.05) with respect to protein contents among the bread wheat cultivars (Table 3). The protein contents of the grains vary from 7.99% (Millinum) to 13.31% (Kakaba). Higher grain protein contents were observed in wheat cultivars Kakaba, Tay and Simba while lower grain protein contents were observed in the cultivars Millennium, Aidoro, Dodota and Sulà. Results reported by Solomon et al. [4] who got significant difference in grain protein contents of ten Ethiopian bread wheat cultivars grown under Arsi condition to vary from 7.7% to 13.2%. Anjum et al. [18] reported variation in protein content from 9.68% to 13.45% among Pakistani wheat varieties. Wilson et al. [15] also reported that the protein contents of six bread wheat cultivars grown over three years vary from 8.7 to 12.9%, which is in similar range with the results of the current study.

product quality, and opportunity for premium price [13]. These results are in close agreement with the study done by Sadowska et al. [14] on four winter and four spring bread wheat cultivars of Poland and obtained results which fall between 75% to 90% for most (75%) of the test cultivars and others between 30% and 60%.

Particle Size Index (PSI)

Statistically significant variation (P<0.05) was observed with respect to percentage PSI and varied from 8.7 to 12.9%, which is in similar range with the results of Wilson et al. [15] who found percentage PSI ranging from 16.5% to 39.5% for 5 bread wheat cultivars tested over three years. Kernel hardness, which describes endosperm texture, is regarded as the most important single characteristic used in wheat classification and influences the functionality of common wheat, except gluten strength and its associated factors. An increase in kernel hardness results in an increase in energy input during milling, flour granularity, damaged starch, water absorption, gas production and properties [16]. According to AACC [7], wheat can be classified in to eight classes on the bases of percentage PSI. Based on that, one can classify wheat cultivars under the current study as very hard (Somber, Pavon 76 and Simba), hard (Danda'a, Dinkinesh, Enseno, Gassay, Hawi and Tossa), medium hard (Gall, Katar, Kubsa, Sirbo, Sula and Kakaba), medium soft (Kgb-01), soft (Dodota and Millennium), very soft (Bolo and Mada Walabu) and extra soft (Aidoro, Dinkesh and Tay). From the result, most (>65%) of the test cultivars fall under medium hard to very hard categories, 21% of them under medium soft to very soft classes and the rest (13%) of them under extra soft categories (Table 3).
This study was conducted on twenty-four bread wheat cultivars of Poland. The WG contents varied from 17.1% to 33.60% for different winter and spring wheat cultivars. The WG content of wheat cultivars in the present study may be attributed to the differences in genotypes and the environmental conditions like temperature and rainfall as reported by Wrzegly et al. [23].

### Dry wheat content:
Dry wheat contents of the test cultivars varied from 7.18% (Dodota) to 14.05% (Kakaba) and shown significant difference (P<0.05) among bread wheat cultivars. The highest dry wheat content obtained 14.05% (Kakaba) was significantly different from the rest of the cultivars under the study. The dry wheat content of wheat cultivars under this test which vary from 7.18% to 14.05% are comparable with the findings of Seleiman et al. [24] who reported significant variation in dry gluten contents among different Egyptian wheat cultivars in the ranged from 10.4% to 13.5%. The gluten protein content determines the flour quality and has significant impact on bread making quality. Paliwal and Singh [22] who also reported that wet gluten in the range 12.77% to 44.06% in Uttar Pradesh wheat varieties. The variation in wet gluten among the wheat cultivars found in the present study may be attributed to the differences in genotypes and the environmental conditions like temperature and rainfall as reported by Wrzegly et al. [23].

### Higher protein content (>12%) is the property of hard bread wheat and it is suitable for leavened bread preparation [19]. Qarooni et al. [20] described that flour with protein content ranging from 10% to 12% is suitable for leavened bread preparation [19]. Qarooni et al. [20] described that flour with protein content ranging from 10% to 12% is suitable for leavened bread preparation. This characteristic is important because it affects the bread's texture, taste, and shelf life. Pasha et al. [21] who also showed that wet gluten in the range 12.77% to 44.06% in Uttar Pradesh wheat varieties. The variation in wet gluten among the wheat cultivars found in the present study may be attributed to the differences in genotypes and the environmental conditions like temperature and rainfall as reported by Wrzegly et al. [23].

### Table 3: Physicochemical properties (protein content, gluten properties and ash and amylase contents) of bread wheat cultivars.

| Variety  | % P   | %WG    | %DG | %Gl  | %GWA | SDS(ml) | %Ash | % Amylase |
|----------|-------|--------|-----|-------|-------|---------|------|-----------|
| Aldorado | 8.72% | 23.90% | 7.62 | 94.81 | 16.27 | 42.57   | 1.50 | 30.09     |
| Bolo     | 9.88% | 26.76% | 8.88 | 95.17 | 17.88 | 44.15   | 1.38 | 26.39     |
| Dand'a   | 10.84%| 31.90% | 9.60 | 85.32 | 22.30 | 73.52   | 1.45 | 28.86     |
| Digalu   | 11.16%| 30.64% | 9.30 | 91.21 | 21.34 | 55.00   | 1.53 | 29.08     |
| Dinkinsho| 10.69%| 29.76% | 9.55 | 58.80 | 20.21 | 36.13   | 1.68 | 23.52     |
| Dodota   | 9.19% | 22.00% | 7.18 | 96.50 | 14.82 | 54.08   | 1.63 | 30.65     |
| Ensero   | 10.69%| 31.29% | 9.64 | 97.61 | 21.65 | 51.41   | 1.40 | 25.25     |
| Gall     | 11.36%| 31.51% | 9.93 | 85.03 | 21.57 | 52.51   | 1.40 | 23.91     |
| Gassay   | 12.02%| 33.23% | 9.89 | 93.26 | 23.70 | 84.00   | 1.22 | 25.60     |
| Hawi     | 10.12%| 32.02% | 11.24| 95.13 | 20.78 | 49.51   | 1.42 | 26.10     |
| Kakaba   | 13.31%| 40.70% | 14.05| 79.78 | 26.65 | 72.74   | 1.52 | 28.68     |
| Katar    | 12.23%| 30.29% | 9.61 | 93.50 | 20.68 | 54.69   | 1.51 | 27.33     |
| Kbg-01   | 11.18%| 29.45% | 8.62 | 94.45 | 20.83 | 77.16   | 1.30 | 26.55     |
| Kubsa    | 11.16%| 32.77% | 10.72| 66.66 | 22.04 | 52.30   | 1.46 | 23.20     |
| M. Wabalu| 10.47%| 30.34% | 9.33 | 88.60 | 21.01 | 31.65   | 1.56 | 23.61     |
| Millennium| 7.99%| 35.37% | 10.62| 71.52 | 25.29 | 45.91   | 1.37 | 28.56     |
| Pavn-76  | 12.21%| 33.08% | 11.06| 92.08 | 22.02 | 88.50   | 1.33 | 23.26     |
| Simba    | 12.74%| 41.40% | 12.58| 70.46 | 28.82 | 44.38   | 1.36 | 24.11     |
| Sirbo    | 11.56%| 40.58% | 12.79| 94.51 | 27.79 | 77.13   | 1.40 | 30.89     |
| Sofumar  | 10.85%| 15.31% | 8.14 | 71.27 | 5.37   | 44.93   | 1.54 | 26.30     |
| Sula     | 9.78% | 26.26% | 8.00 | 88.68 | 18.22 | 56.20   | 1.29 | 27.09     |
| Tay      | 12.83%| 38.55% | 10.97| 45.02 | 27.58 | 49.25   | 1.46 | 27.86     |
| Tossa    | 11.05%| 27.03% | 8.12 | 89.42 | 18.92 | 64.14   | 1.41 | 23.91     |
| Mean     | 10.96%| 30.97% | 9.87 | 84.44 | 21.10 | 54.91   | 1.44 | 26.55     |

Values with different letter within a column are significantly different (p < 0.05) by LSD, %P: Protein (%) at 12.5% moisture bases; %WG: Gluten Water Absorption (%); %DG: Dry gluten (%); %Gl: Gluten Index (%); %GWA: Gluten Water Absorption (%); SDS: Sodium Dodecyl Sulfate sedimentation in ml (at 14% moisture bases); CV: Coefficient of Variation; LSD: Least Significant Difference. Values are mean ± standard deviation.
Gluten index: The gluten index provides information on both quantity and quality of wet gluten. It is also a criterion in defining whether the gluten quality is weak, strong, or normal and it is a standard quality descriptor of high or low molecular weight proteins. Statistical results on behalf of wheat gluten index indicates a high significant difference (P<0.01) among the gluten index of the bread wheat cultivars (Table 3). Gluten index which indicates the gluten strength of wheat varied from the highest 98.6% (Dodota) followed by Enseno (97.61%) to the smallest 45.02% (Tay).

Based on GI, Cubadda et al. [26] proposed seven gluten quality classes in durum wheat. Gluten index values between 65% and 80% are considered good while values above 80% are excellent. Based on this, in the current study (>69%) of the wheat cultivars got high (>80%) gluten index values, more than 21% of them in good range and the rest Dinkinesh and Tay (8.7%) fall under poor quality range which is indicator of higher low molecular weight gluten subunit. The current study is in close similarity with the work of Jakubauskiene and Juodeikiene [27] where GI varied from 11 to 95%.

SDS sedimentation volume: The SDS sedimentation volumes of the wheat cultivars varied from the lowest 31.65 (Mada Walabu) to the highest 77.13 ml and 77.16 ml for bread wheat cultivars Sirbo and Kgb-01 respectively (Table 3). The SDS sedimentation volumes of Danda’a and Kakaba were considerably higher than the rest except for Sirbo and Kgb-01. Except some of the varieties, most of them have shown significant differences (P<0.05) with respect to SDS-sedimentation volumes among each other. Except Sirbo and Kgb-01, Danda’a and Kakaba, Kubsa, Enseno and Galli, Tay and Hawi, Sofumer and Millinium, Simba and Bolo all the cultivars have shown significant difference in SDS sedimentation volume (P<0.05) from the rest.

The SDS-sedimentation volume is an estimate of the protein strength relating to the wheat quality, which depends on the degree of hydration and degree of oxidation of proteins in the wheat. Sedimentation values can be in the range of 20 ml or less for low-protein wheat with weak gluten to as high as 70 ml or more for high-protein wheat with strong gluten [28]. More SDS-sedimentation volume (>30 ml) indicates more gluten strength of protein [9] and will be better for bread.

Coskuner and Karababa [29] reported the range of SDS-sedimentation value from 42.5 ml to 59.6 ml. According to reported by Narasimha [30], SDS sedimentation volumes of three wheat cultivars grown under different environmental conditions over two years have ranged from 59 ml to 90 ml which is in close similarity with this study. For the current study SDS sedimentation volume varied from 31.65 ml to 77.16 ml. The differences in SDS sedimentation volumes of the present study might be due to the differences in genetic makeup of wheat genotypes. Based on the SDS sedimentation volume results it can be possible to classify bread wheat cultivars into strong and medium strong gluten classes.

Ash content: The ash content which varied from 1.2% (Gassay) to 1.68% (Dinkinesh) showed significant difference (P<0.05) among the bread wheat cultivars (Table 3). Dinkinesh got the highest and significantly different (P<0.05) ash content as compared to the rest of the cultivars except for Dodota. The ash contents of Sofumer, Kakaba, Katar, Digalu and Aldoro having values 1.50% to 1.54% appeared significantly different from the rest of the other varieties. There was also no significant difference (P>0.05) among ash contents of Danda’a, Hawi, Kubsa, Mada Walabu, Tay and Tossa. In this study, most of the cultivars (69.56%) have ash content which fall between 1.4% to 1.7%, the rest (30.44%) of the cultivars had ash contents between 1.2% to 1.4%.

The presence of higher ash content indirectly reflects the availability of more amounts of minerals and lower starch. The ash content is also one of the best indicators of flour yield. Hence, the wheat variety with lower content of ash may have more endosperm and ultimately yield good flour extraction [9]. The environmental conditions and stages of wheat grain maturation may affect the ash content. The differences observed in the ash content in the present study among wheat cultivars may be ascribed to differences in wheat genotypes. The ash content of wheat cultivars had been reported to be influenced by genetic as well as non-genetic factors like soil, climatic conditions, and use of fertilizer.

The results of this work were in close agreement to the earlier findings reported by Pasha [25], who found variation in ash content of whole wheat flour from (1.08% to 1.85%). Maghirang [31], also reported that the ash content can vary from 1.30 to 1.93% for hard red winter and 1.27 to 1.93% for hard red spring wheat cultivars.

Amylose/amylopectin ratio: Significance differences (P<0.05) was observed with respect to amylose percentage among the bread wheat cultivars (Table 3). The amylose contents of the grains vary from 30.89% (Sirbo) to 23.20% (Kubsa). The amylose percentage in bread wheat cultivars Sirbo, Dodota, Aldoro and Digalu were significantly higher than the rest. Low amylose percent was observed in bread wheat cultivars Kubsa, Tossa, Mada Walabu and Dinkinesh having values (23.2%, 23.39%, 23.61%, and 23.52%) respectively. The results showed that there were no significant differences (P>0.05) among wheat amylose contents of Bolo and Hawi, Enseno and Gassay even though, they were significantly different from the rest varieties.

Many of the properties of cereal starches that determine their suitability for end-use are dependent upon their amylose/amylopectin ratios. These properties include gelatinization and gelation characteristics, solubility, the formation of resistant starch, and, textural characteristics of whole grains [32]. Amylose percentage in normal cereal starches ranges from 15.5% to 35%. Review by Bultossa [33] shows that in the normal starch, amylose comprises 18% to 33% whereas amylopectin is 72% to 82% of the granule. Normal wheat starch typically contains 20% to 30% amylose and 70% to 80% amylopectin [34]. Amylose content of bread wheat cultivars tested in this work was in the range for normal bread wheat starch with some variations among varieties.

Summary, Conclusion and Recommendations

Grain yield and disease resistance are the most important selection criteria in Ethiopian wheat breeding program. There is a great demand for bread wheat cultivars with the required qualities and the past research works are limited in this aspect where information on physicochemical and rheological quality parameters is necessary to assess the suitability of wheat cultivars for different industrial products. The emergence of food industries utilizing wheat and its primary products are increasing and need to select for high and characterised grain and flour quality factors to match end use. The objectives of the study were to characterise the physicochemical properties of bread wheat cultivars and classify the cultivars considered as soft, medium hard and hard bread wheat cultivars based on quality traits characterized.

The results showed a significant difference in almost all quality parameters except for HLM which is non-significant. Thousand kernel weights generally fall under small to medium grain, where bread wheat cultivars Mada Walabu, Enseno, Dinkinesh and Galli got the highest values. Grain vitreousity showed a direct and significance association with grain hardness. The VK was associated positively and significantly
to protein, wet and dry gluten and gluten water absorption. Bread wheat cultivars Simba, Pavon 76, Sirbo and Sofumar having highest vitreous kernel values also got significant and higher protein quantity, wet gluten (except Sofumar which have low WG content) and dry gluten percent. The lower wet gluten content of Sofumar is most probably due to higher percent of water soluble protein fraction and lower gluten water absorption as it contains higher crude protein content. Since vitreous kernel negatively and significantly associated with percentage PSI, these cultivars got lower percentage PSI that is the property of hard wheat. On contrary cultivars Dodota and Alidoro having significantly the lowest vitreous kernel, also got lower protein, wet and dry gluten and higher percentage PSI which is the property of soft bread wheat suitable for cake and noodle production. Significant genotypic variations were observed among bread wheat genotypes in protein quantity and quality. Genotypes KÃ¡kaba, Simba, Pavon 76 and Tay were superior in both protein quantity and quality regarding while Millennium, Alidoro, Dodota and Bolo were inferior genotypes.

Bread making quality of bread wheat cultivars also evaluated by gluten index and SDS sedimentation volume, have shown significant variation due to bread wheat genotypes. Bread wheat verities Kbg-01, Sirbo, Dandaá and Kakaba having highest SDS sedimentation volume also have higher gluten index. Bread wheat genotypes, Pavon-76 (the standard), Simba and Sofumar are those cultivars categorized as very hard, Kakaba, Dandaá, Hawi, Gassy, Enseno, Tossa and Dinkinesh are hard classes, Kuba, Katar, Sula, Galil and Sirbo were categorized as medium hard all used in the production of leavened bread. Kbg-01 as medium soft, Dodota, Mellenium as soft, Mada walabu, Bolo and Alidoro as very soft, Tay, and Digalu are bread wheat cultivars are bread wheat cultivars having extra soft character used in the production of soft wheat products.

Based on results of physicochemical quality parameters evaluated, it is difficult to get wheat variety, which fulfills all the criteria required for bread making. Considering most grain quality characters, bread wheat cultivars Simba, Pavon 76, sofumar, Kakaba, Sirbo and Kbg-01 can be considered as having superior bread making quality. Cultivars Dinkinesh, Mellenium, Mada Walabu, Alidoro, Tay and Digalu are bread wheat cultivars suitable for making soft wheat products. To get a clear cut for physicochemical properties of these genotypes, studies involving multi-locations and seasons have to be conducted.

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