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Research Article

Comparative study of the physicochemical characteristics of three local durum wheat varieties (Chain S, Vitron R1 and Vitron)

Faouzia HAFFARI[1,♠], Malika BOUALEM[1], Saida BERGHEUL[1], Abdelkrim DJABER[2], Aicha MERZOUG[1]

[1] Plants protection laboratory, Faculty of Natural and Life Sciences, Department of Agronomy, Abdelhamid Ibn Badis University BP 300, Mostaganem, Algérie 27000

[2] Laboratoire de séchage solaire de l'Unité de Recherche en Energies Renouvelables en Milieu Saharien Adrar, Algérie

♠ Contact: faouzia.haffari@univ-mosta.dz

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Abstract

Cereals constitute an important food resource for humans and breeding animals. Durum wheat (*Triticum durum)* is one of the most used species, hence its socio-economic interest. In Algeria, durum wheat is one of the strategic crops that guarantee food security. This study was carried out with the aim of studying the physicochemical properties of local durum wheat; three varieties collected from 2018/2019 production were the subject of these analyses. The choice of these varieties is justified by their availability in the storage facilities (CCP Adrar and UCA Mostaganem). Those are Chaine S and Vitron R1 cultivated in Adrar region, in arid climate, and Vitron from Ain Témounchent region in semi-arid Mediterranean climate. This study was realized at the vegetables protection laboratory of Mostaganem University and the solar drying laboratory of the Research Unit for Renewable Energy in the Saharan environment (URERMS) of Adrar.The studied parameters are summarized in the specific weight, thousand grain weight, humidity rate, ash rate, fatty acidity, protein rate and lipid rate. The results showed that Vitron R1 variety had a maximum specific weight of 79.8kg/hl, a weight of 49.23g per thousand grains, 14.32% of relative humidity rate, 0.78% of ash, 0.01% of fat acidity, 1.36% of lipids and 15.16% of proteins. While Vitron recorded a weight of 77kg/hl, a weight of 48.84g per thousand grains, a relative humidity rate of 13.02%, 1.71% of ash, a fatty acidity of 0.02%, 1.36% of lipids and 14.25% of proteins. On the other hand, Chaine S recorded a weight of 78.9 kg/hl, a weight of 49.67 g per 1000 grains and rates, ash, fatty acidity, proteins and lipids rates respectively of 15.28%, 1.18%, 0.02%, 15.96% and 1.44%. The results obtained during this study revealed that the durum wheat varieties studied showed an important physicochemical compound, thus revealing a good quality of wheat in the both regions Adrar and Mostaganem.

Keywords: Algeria, Durum wheat, Varieties, Physicochemical analysis.

Introduction

Cereals are the main sources of human and animal nutrition in the world. Wheat ranks first in world production and second, after rice, as a source of food for human populations (Naceur 2016). The cereal sector is one of the main agricultural production sectors in Algeria. Cereals and their derivatives are the backbone of the Algerian food system, providing more than 60% of the calorific intake and 75 to 80% of the protein intake of the food ration (Abderrazak and Fouad, 2020 ; Djermoun 2009).

Durum wheat is the third most cultivated cereal in the world, it is adapted to more diverse environments than bread wheat, and it performs very well in semi-arid regions. World production of durum wheat represents 5-8% of bread wheat production. Durum wheat grain is generally very hard with high protein content, amber in color and glassy (Kadkol and Sissons, 2015). About 60% of the world's durum wheat production is concentrated in the Mediterranean basin, including parts of Western Asia, Northern Africa and Southern Europe (Grant *etal*., 2012). Wheat is the main ingredient that contributes to the nutritional properties of all these products. Also it is the main source of carbohydrates, protein, fibers, minerals and vitamins in the human diet (Jribi et al, 2019).

The basic chemical composition of mature wheat grains varies within a relatively narrow range and depends on both genetic factors (species and variety) and growing conditions (e.g. soil, climate and fertilization) (Wieser et al, 2020).

Genetic improvement of durum wheat dates back to the end of the 19th century and has always focused on improving yield, resistance to biotic and abiotic stresses and improving physico-chemical properties to meet the needs of farmers, processors and consumers. Although the traits conditioning productivity and quality of durum wheat are genetically controlled, several

authors report a preponderant effect of the environment on these traits (Melki et al, 2015).

In recent years, several researches have been carried out on the genetic, yield and quality improvement of durum wheat for adaptation to environmental conditions (biotic and abiotic), to ensure food security and good technological quality. In Algeria the climatic diversity ensures a varied production of durum wheat during a year, and a different nutritional quality. The main objective of this work is to study the quality of physico-chemical compositions of local durum wheat varieties and the influence of the planting region.

Materials and methods

Plant materials

Three varieties collected from the 2018/2019 production in the storage facilities of CCLS Adrar and UCA Mostaganem. Namely, Chaine S and Vitron R1 grown in the Adrar region, under an arid climate; and the Vitron variety from a production in the Ain Témounchent region under a semi-arid Mediterranean climate. The parameters determined in this study are physico-chemical analyses of durum wheat grains.

Weight per hectolitre

The mass per hectoliter, known as the density, commonly called "specific weight" (SP), corresponding to the mass of wheat contained in one hectoliter. The PS is determined according to the NF V03-719 standard (1988**).**

The weight of 1000 grains (PMG) (g)

The PMG is determined in accordance with standard N.F. 731 (1989) and OJ N₀ 01 (2013). It is the mass of 1000 grains counted with a NUMIGRAL type photoelectric counter.

Water content

The determination of the water content was carried out in accordance with standard NA: 1.1.32 (1990) and OJ N₀. 08 (2013), the uncovered capsule containing 5g of semolina, the test sample for each variety and the lid were placed in the oven set at 130 ± 3°C for 2 hours.

The water content expressed as a percentage and by mass of the product as given by the following formula:

$$H\ (\%) = (M_1 - M_2 / M_0) \times 100$$

H: moisture content; M_0: is the mass, in grams, of the test sample; M_1: is the mass, in grams, of the cap, lid and test sample before drying; M_2: is the mass, in grams, of the cap, lid and test sample after drying.

$$\text{Dry matter}\ (\%) = 100 - H\ (\%)$$

Fat acidity

The acidity was determined by titrimetric determination to determine the total natural acid content of the samples according to NF. ISO 7305 (1986) and OJ N₀. 08 (2013). An alcoholic extract was prepared from 5g of semolina incubated for 24h in a 95° alcohol solution at laboratory temperature, centrifuged and an aliquot of the supernatant titrated with 0.05N sodium hydroxide. The acidity expressed in grams of sulphuric acid per 100g of material as follows:

$$A\ (\%) = 7.35 \times (V_1 - V_0) \times T / m$$

A: fat acidity; V_1: volume, in milliliters, of the sodium hydroxide solution used for the determination; V_0: is the volume, in milliliters, of the sodium hydroxide solution used for the blank test; m: mass, in grams of the test sample; T: exact titer of the sodium hydroxide solution used.

Ash content

The ash content of the samples to be analysed is determined according to ISO 2171 (2007) and OJ N₀. 35 (2006), by incinerating 5g of semolina of each variety at 550°C for 4 hours until complete combustion of the organic matter; the residue obtained is then weighed. The ash content, as a mass fraction in relation to the wet matter expressed as a percentage, is given by the equation:

$$TC\ (\%) = (m_2 - m_1) \times 100 / m_0$$

m_0: mass in grams of the test sample; m_1: mass in grams of the incineration capsule; m_2: is the mass in grams of the incineration capsule and the incineration residue; H: water content, in percentage by mass of the sample.

Total protein content

The total protein content is determined according to AFNOR NF V03-05, by determining the total nitrogen content according to the method of Kjeldahl (1973), which is based on the wet mineralization of the sample using sulphuric acid in the presence of a catalyst that facilitates and accelerates the reaction (potassium sulphate). The nitrogen content in relation to the wet matter is given by the following formula.

$$N\ (\%) = 0.014.T\ (V_1 - V_0).100/m$$

N: nitrogen content; T: normality of the sulphuric acid used for the titration; V_1: volume, in milliliters, of the sulphuric acid solution poured by thetitrate during the assay; V_0: volume, in milliliters, of the sulphuric acid solution poured by the titrate during the blank test; m: mass, in grams, of the test sample.

$$\text{Protein content}\ (g/100g) = N(\%).\ K$$

K: 5.7 in the case of wheat

Lipids

The total lipid content is determined according to NF. ISO 734 - 1 (2000); 10g of semolina is placed in an extraction cartridge, covered with a grease-free cotton wool pad and subjected to continuous extraction with petroleum ether or any appropriate solvent in a Soxhlet extractor.

Statistical analysis

Data on the physicochemical composition of the three reconstructed durum wheat varieties were subjected to analysis of variance (ANOVA) using SPSS 26 software.

Results and discussion

The results of the physical parameters (Table 1) showed that the three local durum wheat varieties scored well by national and international standards. The results of thousand-kernel weight of Chaine S Vitron R1 and Vitron are higher than the Algerian standards (PMG ≤ 45g). According to Zouaoui (1993) and Chaker (2003), the environmental conditions in Algeria have an influence on the 1000-grain weight. All analyses of variance are highly significant ($P<0.05$). Furthermore, the specific weight values vary between 77 and 78.6kg/hl for the three varieties

studied. These data are in accordance with Codex STAN (1995), FAO (2007) and the Algerian standards (PS>78 of durum wheat).

Table 1: The physical parameters of the three local durum wheat varieties.

Parameter	*Durum wheat varieties*		
	Chaine S	Vitron R1	Vitron
Lang (cm)	0.7±0.05	0.8±0.08	0.7±0.08
Width (cm)	0.3±0.05	0.4±0.05	0.3±0.05
Ps (Kg/hl)	78.6±1.06	78.4±1.09	77±1.04
PMG(g)	48.89±0.35	49.84±0.13	47.72±0.16

Values are means± standard deviation (n=3)

Table 2 shows the different chemical components for the three local durum wheat varieties. The moisture content or grain moisture has values of 15.28%, 14.33% and 14.16% respectively for Chain S, Vitron R1 and Vitron. These values are lower than the maximum value required by Codex STAND 178-1991 (14.5 to 15%), which shows that all varieties are within the standards for moisture percentage.

For the ash content and in comparison with the Algerian norms (1.6 to 2.1 %), we indicate that they are in conformity with the indicated standards. Indeed, the ANOVA test showed that there was no significant difference between the three local durum wheat varieties. The high dry matter content of the tested varieties ensures a very good storage life.

The protein content of the durum wheat grain is the most important criterion for quality assessment, and according to the authors, this content is conditioned on the one hand by the genotype factor and on the other hand by the cultivation conditions (Feillet 2000). In the set of varieties analyzed we observed a significant difference ($P < 0.05$) in the protein value of 15.96% and 15.16%, it is highly significant for Chaine S and Vitron R1. Both varieties are considered as "good quality" semolina; Vitron is rich in protein with a highly significant value of 14.25%. The protein content of cereal grains is around 10%, with large variations depending on the variety and growing conditions (e.g. the content varies between 9 and 16% in wheat). Protein content is an important quality of wheat and flour. The higher protein content, the more likely it is that the flour will be used to make bread and pastries. The lower the protein content, the more likely it is to be used for biscuits (Saulnier 2012).

According to Cherit (2000), the protein content has a double interest, one nutritional and the other technological, and is considered as a quality index.

Table 2: The chemical parameters of the three local durum wheat varieties.

Parameter	Varieties		
	Chaine S	Vitron R1	Vitron
Protein (%)	15.96 ± 0.17^{c}	15.16 ± 0.36^{bc}	14.25 ± 0.61^{b}
Ash (%)	1.18 ± 0.20^{ab}	0.78 ± 0.13^{a}	1.71 ± 0.56^{ab}
Fat acidity (g/100g)	0.02 ± 0.01^{a}	0.01 ± 0.01^{a}	0.02 ± 0.0^{a}
Lipides (%)	1.44 ± 0.08^{a}	1.36 ± 0.04^{a}	1.36 ± 0.13^{a}
Dry matter (%)	84.72 ± 3.63^{a}	85.67 ± 0.49^{a}	85.84 ± 0.81^{a}
Water (%)	15.28 ± 0.27^{a}	14.33 ± 0.48^{a}	14.16 ± 0.99^{a}

Values are means± standard deviation (n=3); ^{a,b,c} *significant difference (* $p<0.05$*)*

Fat shows significance ($P<0.05$) at 1.44%, 1.36% and 1.36% respectively of Chaine S, Vitron R1 and Vitron. Lipids can be defined as chemical compounds with pronounced hydrophobicity, soluble in non-polar organic solvents and insoluble in water. Wheat grains contain about 1.5-2.5% lipids (Wieser et *al*, 2020). This wealth may have a positive effect on the quality of the final product of local varieties.

The results obtained for the different analyses carried out for Chain S, Vitron R1 and Vitron, it can be deduced that they are rich in nutrients and have very important physico-chemical properties. These results can be integrated in the food safety management to ensure the quality of stored wheat and their stored food derivatives.

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