Mesopotamia J. of Agric. Vol(33
)No. (1)2005

EVALUATION OF GRAIN QUALITY PROPERTIES OF SOME IRAQI AND ICARDA SELECTED DURUM WHEAT CULTIVARS

Ahmed Salih Khalaf
Mosul University, Iraq
Aziz Ibrahim Hassan
Dohuk University, Iraq
Miloudi Nachit
ICARDA, Aleppo, Syria
Ahmad El-Saleh
ICARDA, Aleppo, Syria

ABSTRACT

Four samples of Iraqi durum wheat cultivars and six selected varieties of ICARDA were involved in this study, for their grain quality tests and flour rheological properties comparison. Their gliadin electrophoresis was also conducted. Results showed a significant variation among tested varieties for the grain characters, protein quantity and quality in term of SDS-sedimentation test. The highest levels of SDS-values and SDS-index were recorded for Haurani, Korifla, Gidara-2, and Om rabi-5, but Caronia is the best in pigments. Among the tested cultivars, Iraqi cultivar Caronia resemble the Syrian one (Haurani) in giving positive reaction with phenol test. Concerning with the gliadin subunits electrophoregrams patterns, cultivars can be classified into two groups, those possess the gamma gliadin components designated 45 and the linked omega gliadin 35, include cultivars (Caronia, Acsad-65, Simeto, Creso, Om rabi-5, Haurani, Korifla and Gidara-2, while those possess gamma gliadin 42, included cultivars (Waha, , and Cham-5).

INTRODUCTION

Durum wheat (*Triticum durum Desf*) consider one of the most important cereal crops, more than 85% of the world durum production area is located in the Mediterranean basin. Manufacturing and marketing of the products are also concentrated in the region Nachit, 1998). It is utilize by people differently, such as Bulghur, Kuba, or Habia, Noodles, Macroni, Spaghati ….etc. Varieties vary for their suitability to these dishes.

In Iraq, durum grown at lesser extent than bread wheat, it is mainly found in the Northern governorates of Iraq, and mostly under rain-fed conditions, where annual rainfall ranges between 350-500mm (Al-Ansary, 1982; Al-Younis *et al.*, 1987; and Adary *et al.*, 2002). The variations were almost attributed to the genetic diversity in addition to the agro-ecological and environmental conditions, and cultural practices (e.g. cropping system, previous crop in rotation, fertilization, and annual rainfall). The yield productivity is low and it is stability is related to the fluctuation in annual rainfall. Several local and introduced varieties are grown in Iraq. Breeders had mainly dealt with grain yield but less with grain quality. Great efforts have to be done by researchers to develop productive genetic materials combining high grain quality with resistance to the main abiotic and biotic stress

in the Mediterranean region and the ultimate goal is to simultaneously increase yield and improve end-use grain quality of durum developing countries (Abdalla *et al.,* 1995). The present study was planned to evaluate the grain quality of some Iraqi durum wheat varieties in comparison with those selected from ICARDA for their grain quality criteria and flour rheological properties.

Received 20/12/2004 Accepted 8/2/2005

MATERIALS AND METHODS

Several durum wheat cultivars which supplied from Iraqi official research centers at Mosul and Dohuk governorates; namely (Caronia, Creso, Simeto, and Acsad-65) others six of ICARDA lines either those released in Iraq (Waha-Iraq, Korifla) or are promising in Iraq, Cham-5, Om rabi-5, and Gidara-2, in addition to the most widely grown landrace in Syria (Haurani) which also spread in the entire Middle east region with an excellent adaptability to different dry land conditions, were involved in this study. Grain protein and ash content in percentage as a whole were determined using Near-Infrared instrument (El-Haramein *et al.*, 1998); 1000-kernels weight was determined using Numigral seed counter of Tripette & renaud, test weight with Seedburo equipment company; Grain moisture content as percentage with Motomco moisture meter of electronics, Div. Paterson, N.J. USA. Modified phenol reaction test was also applied for varieties verification. Two replicate samples of 30 seeds each were soaked in tap water for 24 hours; thereafter, seeds were placed on filter paper moistened with 3ml phenol solution (1% w/v) in 9cm diameter Petri-dish (ISTA, 1966; Csala, 1972). Treated seeds were incubated at 25°C. Seeds were examined after four hours and classified into three categories according to color change (deep dark brown ++, faint color +, and no change -). Flour rheological properties were tested using Farinograph (Williams *et al*., 1988). Sodium dodecyl sulphate (sedimentation test) used for assessing gluten strength. Proteins with good hydration capacity give stable suspension, which is directly related to the strength of the wheat protein. The higher the sedimentation volume (ml), the greater the gluten strength, while SDS index, which is the ratio between SDS volume (ml) and protein content % was also calculated to overcome the misleading of SDS alone as it is affected by protein content and protein quality methods. The yellow pigments or amber color which is due to the presence of carotenoid pigments, mainly xanthophyl, the stronger color is preferable for durum wheat end-use products. These measurements were all done in accordance to (El-Haramein, 1988). Electrophoresis for gliadin was accomplished using SDS-PAGE, according to the procedure of (Ciaffi, *et al.*, 1993). The gliadin polypeptides had been reported by Damidaux, 1978, to a very strong relationship between banding patterns of gliadin and gluten quality. Gliadin was extracted by 1.5M dimethyl –formamide (DMF) to grain flour. The separating gel comprised of 8.5% acrylamide and 2.62% bis-acrylamide, lactic acid, ascorbic acid and ferrous sulphate solution were all added. The gel was polymerized by

adding H_2O_2.Elecrophoresis buffer solution contain aluminium lactic solution. An amount of 1.7 micro-liter was loaded per slot, gel thereafter subjected to electrophoresis through a vertical slab gel Hoefer SE-600 electrophoresis unit, at a constant current 25mA at 18°C for two hours. Gel then stained with Coomassie Brilliant blue-R-250 1% in ethanol and 12% trichloro-acetic acid for over night then destained and photographed with image analysis software Bio-ID and image analysis hardware. Several of measured parameters were subjected to analysis of variance in one–way (no blocking) with three replications per treatment using Gen Stat program, Fishers least significant difference was used for treatments mean verification at 0.05 level of significant.

RESULTS AND DISCUSSION

Durum Wheat cultivars shows a significant variation in all measured characters table (1) grain moisture content as percentages, it was attributed to their previous store status and their equilibrium with the store relative humidity. Differences in other grain characters were also obvious; 1000-kernels weight, test weight and vitreousness %, which refer to the genetic diversity in addition to the agro-ecological environmental conditions and cultural practices (e.g., cropping system and the previous crop in the rotation, fertilization, and annual rainfall). It has been reported by Cseus *et a*l., 2002., that the crop-years especially the rains, had a strong effect on the quality of durum wheat, and grain characters such as yellow pigments and gluten extensibility changed very much. On the concept of vitreousness, it is clear that ICARDA cultivars showed higher percentage of vitreous grains than Iraqi cultivars, this could be probably due to the absence of fertilization practice with nitrogen under Iraqi condition. Concerning with phenol reaction test, the Iraqi cultivar Caronia resemble the Syrian one Haurani, both gives a positive color change with phenol; this was attributed to the tyrosinase enzyme activity (Csala,1972), this similarity lead us to think about the possibility of their genetic linkage, particularly after Al-Younis *et al*., (1987) have mentioned that the synonymous name of the cultivar Caronia is Falestine; referring to the locality origin. While other cultivars gave no color change, such results with other durum cultivars was reported by (Khalaf, 1999).

Table (1): Grain characteristics of some Iraqi and ICARDA selected durum wheat cultivars.

Cultivars	Moisture content%	Test weight Kg/hl	1000-kernels weight ,g	Vitreousness%	Phenol test
Caronia	5.85e	78.69g	42.00f	81.33c	+
Acsad-65	6.50c	81.91bc	51.35b	69.00d	-
Simeto	6.74b	80.45e	52.05b	92.33b	-
Creso	6.54bc	81.33d	56.48a	81.50c	-
Waha	8.91a	79.63f	38.13h	98.67a	-
Cham-5	6.20d	83.75a	46.15c	69.00d	-

Om Rabi-5	9.06a	80.79e	42.95df	98.33a	-
Haurani	9.03a	81.41cd	42.63df	98.67a	+
Korifla	9.03a	77.87h	40.13g	97.17ab	-
Gidara-2	9.06a	82.35b	44.02d	98.17a	-

Within each column figures sharing same letters are not significantly differed according to Fishers protected least significant differences at 5%

. The protein content percentage, SDS-test and ash content represented in table (2) revealed that in general, the ICARDA cultivars were similar and had shown higher values than Iraqi cultivars with an exception of Cham-5 which was resemble the Iraqi cultivars. Concerning with flour rheological properties in terms of Farinograph and its interpretation table(3). In general, the ICARDA cultivars were stronger than Iraqi cultivars, with an exception of Cham-5 fig (1). Simple correlation coefficient was also calculated and a positive correlation with sedimentation test value was observed table (4). On the other hand, 1000-kernel weight and test weight gave negative correlation with grain protein content, that is well known that the shriveled grains contain higher protein than plump ones, and it is influenced by nitrogen application and water availability, particularly during grain filling and maturing .Grain vitreousness, also positively correlated with protein content in percentage table (4). These results corroborate those of (Impiglia, 1996), who reported that

Table (2): Grain protein content, sedimentation test, yellow pigments and ash content for some Iraqi and ICARDA selected durum wheat cultivars.

Cultivars	Protein% db	SDS ml	SDS, I	SDS, n	Pigment, ppm	Ash%
Caronia	12.78d	20.00e	1.56d	2.55e	7.00a	2.44d
Acsad-65	11.79ef	18.67f	1.58d	2.20f	5.23f	2.60bc
Simeto	11.88e	22.00d	1.85b	2.61e	5.41e	2.40d
Creso	11.50f	20.00e	1.74c	2.29f	5.39e	2.46d
Waha	14.76a	20.00e	1.35e	2.95d	6.55b	2.73a
Cham-5	12.12e	16.00g	1.32e	1.93g	5.55d	2.58c
Om rabi-5	13.61c	24.00c	1.76bc	3.26c	6.05c	2.70ab
Haurani	14.72a	30.67a	2.08a	4.51a	6.07c	2.75a
Korifla	14.18b	30.67a	2.16a	4.34a	5.41e	2.69abc
Gidara-2	13.87bc	28.67b	2.06a	3.97b	3.91g	2.68abc

Within each column figures sharing same letters are not significantly differed according to Fishers protected least significant differences at 5%.

Table (3): Farinograms interpretation values for some Iraqi and d ICARDA selected durum wheat cultivars.

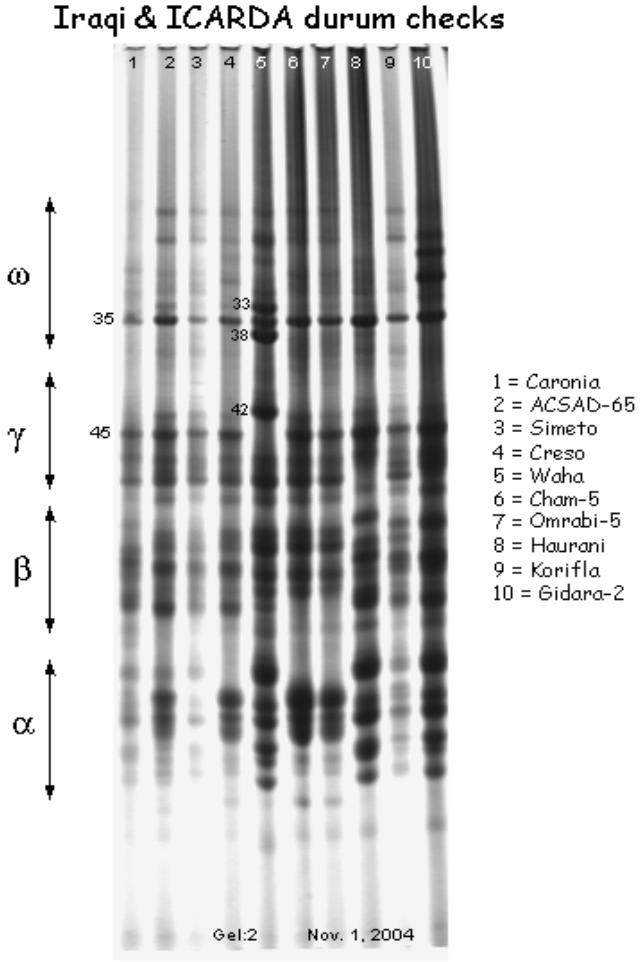
Cultivars	Flour yield %	FAB %	FDT, min	FST, min	FMT, bu
Caronia	67.5	71.0	2.3	1.2	225
Acsad-65	71.0	65.5	2.2	1.3	160
Simeto	69.6	71.0	1.9	2.8	120

Creso	67.9	67.0	2.2	1.4	180
Waha	68.4	68.0	2.6	2.0	160
Cham-5	70.2	67.5	1.9	1.0	180
Om Rabi-5	69.4	69.0	2.5	1.5	120
Haurani	65.8	75.0	3.5	2.4	90
Korifla	69.3	69.5	3.3	2.7	95
Gidara-2	67.7	70.0	2.8	1.9	105

FAB= Flour water absorption FST=Flour stability time
FDT= Flour development time FMT=Flour mixing tolerance

the grain vitreous gives a distinct physical properties to the whole kernels and the best quality durum wheat have highly proportions with vitreousness. The electrophoregrams of gliadin extracts are shown in fig (2), the patterns of gliadin bands were compared to Waha cultivar as for check, the subunits of Iraqi cultivar Caronia and the ICARDA cultivar Haurani are similar, this confirm the results of phenol reaction test similarity. In general, the gliadin electrophoregrams pattern in accordance to Impiglia *et a*l.,1995, who reported that durum wheat cultivars Om rabi, Korifla and some other cultivars possess the gamma gliadin component designated 45 and the linked omega gliadin 35, whereas cultivars Haurani and Waha and some other cultivars possess the gamma gliadin 42 with the associated triplet of omega components 33-35 and 38.While in the present study, cultivars, Caronia, Acsad-65, Simeto, Creso, Om rabi-5, Haurani, Korifla and Gidara-2, possess the gamma gliadin component 45 and the linked omega gliadin 35, whereas, cultivar, Waha, possess the gamma gliadin 42 with the associated triplet of omega components 33,35, and 38, while Cham-5 possess gamma gliadin 42, but omega components was not obvious. Highest levels of SDS sedimentation values and SDS-index were found for Haurani, Korifla, Gidara-2 and Om rabi-5 while Caronia is the best for color. According to farinograph interpretation, the cultivar Haurani show strong quality than others, referring with gliadin bands, it was clear that band 35 and 45 were very dense in addition to other bands at beta resolution area .Such association between some grain quality and specific gliadins band and high molecular weight glutenin subunits, with dough resistance have been reported by (Campbell *et al.*, 1987).

Fig(2): Electrophoregrams of gliadins protein for some Iraqi and ICARDA selected durum cultivars.



ACKNOWLEDGEMENTS

The investigators wish to express their sincere gratitude and appreciation to the College of Agric & Forestry and to the Chief of Party of AHEAD project of Hawaii project, for awarding the opportunity to accomplish this work and for their financial support. Thanks also due to Technical Staff of Durum wheat quality assessment and to Dr. Murari Singh and Mr. Khaled El-Shamaa, for assisting with the statistical analysis.

تقييم خصائص الحبوب النوعية لبعض اصناف الحنطة الخشنة العراقية والمختارة من ايكاردا

احمد صالح خلف
كلية الزراعة والغابات / جامعة الموصل
عزيز ابراهيم حسن
كلية الزراعة / جامعة دهوك

ميلودي نشيط
ايكاردا، حلب ، سوريا
احمد الصالح
ايكاردا ، حلب ، سوريا

الخلاصة

شملت الدراسة على اربعة اصناف من الحنطة الخشنة العراقية وستة مختارة من ايكاردا، لدراسة خصائص الحبوب النوعية والصفات الريولوجية للطحين ومقارنتها. وكذلك تم ارتحال بروتينات الكلايادين بالهجرة الكهربائية. اشارت النتائج الى وجود اختلافات معنوية بين خصائص الحبوب النوعية وفي كمية ونوعية البروتين باختبار الترسيب(SDS) وقد عزى سبب ذلك الى التنوع الوراثي بالاضافة الى التباين الزراعي والبيئي والعمليات الزراعية (النمط الزراعي المتبع والمحصول السابق في الدورة الزراعية، التسميد والمعدل السنوي للامطار)، ومن جهة اخرى فان من بين الاصناف تشابه الصنف العراقي كارونية مع السوري حوراني في اختبار الفينول. وجد اعلى قيمة لاختبار ترسيب البروتين للصنف السوري حوراني وكورفلاوجيدارا-٢ وام رابي-٥ ولكن الصنف العراقي كارونية كان الافضل في اللون العنبري.اما بخصوص الهجرة الكهربائية للكلايادين فقد اختلفت الاصناف في نمط هجرة الوحدات والحلقات وبشكل عام يمكن تقسيم الاصناف الى مجموعتين، احدهما تحوي على الحلقة كاما ٤٥ مع اوميكا ٣٥ وتشمل كارونية، اكساد-٦٥، سميتو، كريسو، ام رابي-،حوراني،٥ وكورفلا وجيدارا-٢ ، بينما المجموعة الاخرى تحتوي على الحلقةكاما ٤٢ والتي تمثلت بالاصناف واحة وشام-٥.

REFERENCES

Abdalla,O.S, R.J.Pena, J.E.Autrique, M.M.Nachit(1995). Durum wheat breeding and quality improvement at CIMMYT Mexico. In Durum wheat quality in the Mediterranean region . Edited by N.Di Fonzo, F.Kaan, M.Nachit.Ciheam.

Adary,A.; A.Hachum; The. Oweis and M.Pala(2002). Wheat productivity under supplemental irrigation in Northern Iraq. ICARDA. On –Farm water husbandry research report series, No.2.

Al-Ansary,M.M.(1982). Production of field crops. Mosul university press.(in Arabic).

Al-Younis,A.; A.Mohammed and A.A.Zaki.(1987). Cereal crops. Mosul university press.(in Arabic).

Campbell,W.P; C.W.Wrigley; P.J.Cressey,and C.R.Slack.(1987). Statistical correlations between quality attributes and grain-protein composition for 71 hexaploid wheats used as breeding parents. Cereal chemistry,64(4):293-299.

Ciaffi,M.; D.Lafiandra, E.Porceddu; S.Benedettelli.(1993). Storage –protein variation in wild emmer wheat (*Triticum turgidum ssp*. dicoccoides) from Jordan and Turkey.1.Electrophoretic characterization of genotypes. Theor App,Genet.86:474-480.

Csala,M.V.(1972). The methodology and mechanism of the phenol reaction in cereals-Proc. Int. Seed Test. Ass.37(3):915.

Cseus,L.; J.Matuz and B.Beke(2000). Annual effect on grain quality of winter durum wheat (*Triticum turgidum L*. var. durum) in Szeged, Hungary. Durum wheat improvement in the Mediterranean region. New challenges. Proceedings of the seminars jointly organized by Ciheam (International center for advanced Mediterranean agronomic studies.Editors, C.Royo, M.M.Nachit,N.Di Fonzo, J.L.Araus.

Damidaux,R.; J.C.Autran; P.Grignac and P.Feillet.(1978). Mise en evidence de relations applicables en selection entre 1 electrophoregramme des

gliadines et les proprietes viscoelastiques du gluten de *T. durum Desf*. C.R.Acad,Sci.Paris. 287:701-704.Cited after A. Impiglia, 1996.

El-Haramein,F.J.; A.Impiglia and M.M.Nachit.(1998). Recent applications of near-infrared spectroscopy to evaluate durum wheat grain quality. Proceedings of the SEWANA durum network workshop.20-23 March.1995.

Impiglia,A.; M.M.Nachit; D.Lafiandra; E.Porceddu (1995). Effect of gliadin and glutenin components on gluten strength in durum wheat. Durum wheat quality in the Mediterranean region. Edited by N.Di Fonzo, F.Kaan, M.Nachit. Ciheam.

Impiglia,A.; G. Nachit; M.M. Nachit; D.Lafiandra; E.Porceddu and L.M.Martin.(1998). Storage proteins in the Mediterranean durum landraces. Proceedings of the SEWANA durum wheat network workshop,20-23,March.(1995). ICARDA, Aleppo, Syria.

International rules for seed testing (1966). Proceedings of the international seed testing association.31: (1).

Khalaf,A.S.(1999). Identification of wheat cultivars for their seeds tyrosine and phenol color print on filter paper. Mesopotamia, J. Agric. 31(4):11-16.

Kosmolak,F.G.; J.E.Dexter; R.R.Matsuo; D.Leisle and B.A.Marchylo(1980). A relationship between durum wheat quality and gliadin electrophoregrams. Can. J. Plant Sci., 60: 427-432.

Nachit,M.M.(1998). Durum breeding research to improve dryland productivity in the Mediterranean region. CIMMYT/ICARDA, Breeding, germplasm enhancement program, ICARDA, Aleppo, Syria.

Williams,P.; F.Jaby El-Haramein; H.Nakkoul and S.Rihawi (1988). Crop quality evaluation methods and guidelines. ICARDA, Aleppo, Syria

Table (4): Simple correlation coefficient between all measured characters

	Ch_pigm_ppm	Ch_SDS_ml	Moisture_%	N_Ash_%	N_Protein_%_	SDSI	SDSn	TKW_g	TW_kg_hl	Vitreous_%
Ch_pigm_ppm	1									
Ch_SDS_ml	-0.282816	1								
Moisture_%	-0.16743	0.771195	1							
N_Ash_%	-0.0670028	0.53178	0.859965	1						
N_Protein_%_db	0.180821	0.677748	0.872782	0.830436	1					
SDSI	-0.450928	0.923524	0.543485	0.233558	0.348818	1				
SDSn	-0.170667	0.977339	0.847061	0.662635	0.815131	0.821705	1			
TKW_g	-0.375537	-0.401181	-0.612756	-0.670988	-0.871416	-0.0517958	-0.56167	1		
TW_kg_hl	-0.489922	-0.314666	-0.202953	0.032868	-0.3568	-0.247223	-0.329504	0.429033	1	
Vitreous_%	-9.96E-16	0.76053	0.85907	0.5146	-0.78425	0.597674	0.801195	-0.530929	-0.443973	١