CHEMICAL STUDIES ON CONDITIONING AND PASTA QUALITY OF SOME WHEAT VARIETIES

BY

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ABSTRACT

The chemical composition and the effect of conditioning lying time of the Egyptian wheat variety Strok's (Triticum durum L.) and an Australian (Triticum aestivum) variety were studied. Factors affecting pasta brownness,quality and cooking were also studied using; three varieties of imported semolina flour (Roma,Capri and Buitoni) beside strok's flour and two imported T. aestivum varieties manufactured pasta (macaoni).Egyptian durum kernels and flour were characterized by its higher ash,crude fiber,protein, sugars and α amylase activity.The conditioning lying time was five hrs. for durum wheat while it was 12 hrs. for aestivum wheat. Durum stork's pasta was brown and had the highest grade color value while,imported semolina pasta was yellow and had the lowest grade color. Aestivum pasta (Amoun and Mataria) had brown and pale brown color and lesser grade value than stork's. Brownness was attributed to varietal, bran contamination, enzymatic and non enzymatic reactions. Semolina and stroks had short periods of dough stability. Strok's showed the highest dough weakening. Amoun had the highest stability and lowest weakening. Aestivum macaroni had lower cooking quality due to its lower increasing of weight and its higher cooking loss.

INTRODUCTION

Durum wheat (Triticum durum Desf.) is prefered over other classes of wheat for the production of pasta products due to its excellent rheological properties,superior color and cooking quality (Dexter and Matsuo, 1978).

The objective of wheat conditioning is primarily to improve the physical state of grain for milling and sometimes to improve the baking quality of the milled flour. Refai (1965) stated that wheat conditioning made direct or indirect interior action in flour which improves its characteristics.Also,alpha amylase which is found in

small amounts in dry grains increased after conditioning process.Anon (1969) reported that grain conditioning made biochemical changes in grains, which have an influence on protein as well specially gluten, saccharides and enzymatic activity. Stenvert and Kingswood (1977) noticed that endosperm structure was of primary importance in controlling water penetration rates and that soft open endosperm structures permitted more rapid water movement than hard structure one.

Brennan (1982) showed that the time required to bring sound,good quality durum to optimum milling condition is from five to six hrs., Longer periods cause pigment changes resulting in loss of color in both semolina,pasta and products.They added that durum wheat is usually milled at moisture content of approximately 16% to yield semolina at 14% moisture content.Kent (1983) reported that the optimum moisture content varies for different wheat types, being higher for hard wheats than for soft wheats.Tawfik and Mansour (1983) cited that T.durum wheat var. Stork was tempered to 16% moisture content and allowed to condition for 24 hrs. Ashour (1985) studied the conditioning of Giza 155 and stork's. The results showed that samples were conditioned at 15% and 16% moisture content for Giza 155 and strok's respectively for 24 hrs.,then each wheat variety was milled.

Using hard or soft wheat (T. aestivum) flour for pasta production rather than durum semolina does not give the final product the acceptable cooking quality. Mansour (1981) stated that the protein and gluten content must be higher than 10% and 23% respectively in flour used in macaroni production. Anon (1983) cited that semolina flour must have protein content not less than 13% on dry basis.

Color of pasta products is an important indicator of quality. Refai (1982) mentioned that color of semolina is a varietal factor. Anon (1983) reported that cooking loss of macaroni made from semolina not exceeds 8% and its swelling index not less than 3% while, macaroni from wheat flour other than durum have minimum swelling index 2 and cooking loss not exceeds 10%

The local sector depends mainly on the imported hard or soft wheat flour (72% extraction) for macaroni processing,which does not give the final product the acceptable yellow color or superior cooking quality. A try to produce pasta from stork's (T.durum) which was cultivated in upper Egypt was carried on,but its results were unsatisfactory due to the brown color of the product.On the other hand macaroni processed from local patent flour (72% extraction) yielded a product with a pale color and low cooking quality

Therefore, the aim of this work is to evaluate the effect of conditioning on pasta quality produced from local storks and the imported soft wheat (Australian wheat).

MATERIALS AND METHODS

Materials:

a- Two varieties of wheat were subjected to determine thier chemical constituents and studying the effect of conditioning lying time on thier flour chemical and rheological properties. The local stork's (Triticum durum) kernels and flour were obtained from the Breading Research Section. Agric. Res. Cent. Ministry of Agriculture.And,Australian soft wheat variety belongs to (Triticum aestivum) kernels and flour were obtained from North Cairo Milling Factory .

b- Three varieties of imported semolina (Roma, Capri and Buitoni) and their manufactured macaroni(Pasta).

c- Two imported T. aestivum flour (72% extraction) used in Sawa manufacture (hard one for Amoun and soft one for Mataria macaroni).

Different samples were subjected to study factors affecting pasta brownness and cooking quality.

b- Methods:

Moisture,ash,reducing and non-reducing sugars, lipids,proteins (Nx5.7) and pigments contents were determined according to A.O.A.C-(1980).Alpha amylase activity was carried out according to A.O.A.C (1980)using Falling Number system. Starch,crude fibers, gluten,non protein nitrogen,browness,grade color and available lysine content were determined according to; Kerr et al.,(1951),Refai (1965), Kent-Jones and Amos (1967),Matsuo and Irvin (1967),Anon (1976) and Hall et al.,(1973),respectively. Rheological properties were carried out using Brabender Farinograph test according to A.A.C.C. (1962).

RESULTS AND DISCUSSION

Chemical constituents of wheat kernels and flour:

The kernels and flour of the two wheat varieties were subjected to chemical analysis. Data in Table (1) show that

Table(1):Chemical constituents of wheat kernels and flour (on dry basis)

Variety	Moisture %	Ash %	Crude fiber %	Total protein %	Non prottein nitrogen %	Gluten wet%	Content dry%	Red sugars %	Non red sugars %	Total sugars	Starch %	a-amylase * activity	Lipids %	Pigments ** p.p.m.
T.durum														
Stork's														
Kernels	10.6	1.94	2.40	14.85	-	-	-	0.90	1.30	2.20	59.56	11.27	2.30	7.88
Flour	15.8	1.05	0.35	13.43	0.42	30.50	14.98	1.14	1.06	2.20	78.58	22.00	1.21	7.10
T.aestivum														
Australian														
Kernels	11.8	1.50	2.00	8.84	-	-	-	0.72	1.10	1.82	69.12	12.95	1.97	2.8
Flour	14.2	0.42	0.20	7.96	0.185	25.00	10.00	0.33	0.77	1.10	87.29	16.67	1.12	2.60

** P.L.N. on 15% moisturebasis.*
*** On 12% moisture basis.*

durum (strok's) kernels and flour had higher ash and crude fibers content than that of Australian aestivum. Durum flour had higher moisture content due to its higher water absorption during conditioning,hence enzymatic activity could be higher in the kernels and the obtained flour and affects alternatively on pasta quality. Strok's kernels or flour contain high ash content which give negative effect on the color of produced pasta. Also, stork's high crude fiber content (0.35%) could be attributed to higher flour extraction more then 72%.

On the other hand as shown in Table (1) durum wheat kernels had higher protein content than that of aestivum while, its extracted flour contained lower protein content. Durum wheat is characterized by its high total sugers (reducing and non reducing) and low starch contents in addition to its high alpha amylase activity. Durum high sugars content could be attributed to starch damage which occurs during milling process (Kingswood, 1975). Also high reducing sugars may be due to the longer conditioning time and humidity which increases the activity of alpha amylase (Anon 1969).Comparing the starch and protein content of T. durum it could be concluded that there are an inverse relation.These results are in agreement with those of Fraser and Holmes (1959). Australian soft wheat and its extracted flour had lower crude lipids and pigments contents.The high crude lipids content for the whole wheat kernels is due to its germ and bran high lipids content (Refai, 1965).

Effect of Conditioning lying Time:

Data in Table (2) show the effect of different lying time from (1 to 24hrs) on the chemical composition of both. T. durum and T. aestivum. Results show that after 1 hr lying time flour contained high amolunt of ash content indicating that separation of husk and endosperm during milling was not complete. T. aestivum contains low amount of ash due to its soft endosperm texture. Flour moisture content increased by increasing lying time, and after one hour of conditioning the moisture content of T. aestivum was higher than that of T. durum. This observation is due to the fact that endosperm structure is primary important in controlling water penetration rates (Stenvert and Kingswood 1977 and Kent, 1983). Data show positive relationship between browning, alpha amylase activity and non protein nitrogen. The alpha amylase activity increased twice in wheat kernels while its increment in flour was very slight.

This phenomenon is due to that α amylase activity is restricted to the aleuron and scutellum layers of mature kernels (Refai, 1965). Both non protein nitrogen and lipids

Table (2):Effect of conditioning lying on T.durum & T.aestivum . (Australion soft).

Lying Time (hrs.)	Flour Yield ext. rate %	Moisture %	Ash %	Lipids content %	Sugars			Alpha-amylase activity (P.L.N)		Non-protein nitrogen %	Pigment ppm	Browning at 400nm A	Reducing sugar non protein nitrogen
					Reduing %	Non reducing %	Total %	Wheat	Flour				
T.durum													
1	72.09	12.9	1.00	2.40	0.38	1.75	2.13	13.27	11.75	0.156	6.6	0.150	Control
5	72.69	14.2	0.89	1.98	0.78	1.38	2.15	13.92	12.13	0.184	7.1	0.160	4.88:1
12	72.88	14.3	0.88	1.53	1.38	1.26	2.64	18.52	13.13	0.234	6.7	0.178	3.10:1
18	72.15	14.2	0.88	1.40	1.46	0.98	2.44	29.00	14.71	0.270	6.5	0.180	2.25:1
24	71.78	14.2	0.88	1.32	1.24	1.06	2.30	32.00	16.57	0.305	6.4	0.188	1.46:1
T.aestivum													
1	72.27	13.9	0.77	2.29	0.45	1.52	1.97	15.00	13.95	0.0499	2.29	0.150	Control
5	72.50	14.0	0.50	2.19	0.90	1.30	2.20	16.80	15.23	0.084	2.54	0.160	4.15:1
12	72.94	14.3	0.62	2.11	1.30	1.19	2.44	20.90	16.18	0.101	2.85	0.177	1.38:1
18	72.56	14.5	0.62	1.88	1.50	1.00	2.50	25.00	17.00	0.130	2.23	0.193	3.25:1
24	72.78	14.3	0.51	1.54	1.07	0.94	2.01	30.20	17.59	0.150	2.68	0.197	1.66:1

Reducing sugar/non protein nitrogen= $\frac{\text{Reducing sugar}}{\text{non protein N at time} - \text{non protein N at 1 hr.}}$

content showed gradual reduction and reached their minimum value after 24 hrs. Such reduction in lipids content could be attributed to lipase activity at high moisture content. However, the reduction of lipids content is associated with an increment in soluble carbohydrates. Prolonging lying time activates different hydrolyzing enzymes. Therefore, reducing sugars were increased while non reducing sugars were decreased and total sugars reached its maximum after 12 and 18 hrs. in T. durum and T. aestivum flour respectively, then reduction took place due to consumption during conditioning. Pigments were at their lowest value in T. durum after 24 hrs. conditioning, this could be attributed to pigment distruction by lipoxidases (Brennan 1982). In the case of T. aestivum conditioning had a slight effect on its low pigment content. The reducing sugar/amino acid ratio showed a reduction from 4.88:1 to 1.46:1 and from 4.51:1 to 1.86:1 in both T. durum and T. aestivum respectively. Which accelerate their pasta brownining (Abd El-salam, 1982).

The Effect of conditioning time on rheological properties:-

The effect of conditioning on farinograph test presented in table(3) and illustrated in fig (1).

Samples of T. durum conditioned for 5 hrs. showed high; dough development, arrival and stability times and valorimeter value while, water absorption and weakening of the dough showed their lowest value. semolina and flour which are low in farinograph water absorption are of great demand for pasta dough property that give hemogenous dough mass for macaroni processing. Therefore conditioning lying time for 5 hrs. is prefered for Egyptian durum strok's to yield pasta of good quality.

The rheological properties of T. aestivum showed that at 12 hrs. conditioning time water absorption was low (57.0%). The mixing and arrival times increased gradually by increasing conditioning time indicating that T.aestivum variety contains stronger gluten content than T. durum. On the other side, durum protein content is higher than aestivum. Pasta quality depends mainly on protein content and the nature of the protein within the gluten complex (Dexter and Matsuo, 1978). At the same conditioning time, dough stability and valorimeter value were high. According to the obtained results, it can be concluded that 12 hrs. Conditioning time is suitable for Australian aestivum to producce flour of good quality.

Pasta Quality:

Color is an important indicator to pasta quality. Results concerning the chemical characteristics of spaghetti macaroni processed from T. aestivum (Amoun and Mataria),

Table(3): Effect of conditioning lying time on rheological properties of T. Durum and T.aestivum.

Conditioning lying time hours	Water Absorption %	Dough development min.	Dough arrival min.	Dough stability min.	Weakening of the dough B.U.	Valorimeter value	Degree of softening after 10 min. B.u.	Degree of softening after 20 min. B.U.
T.durum								
1	63.14	1.3	0.4	5.5	80	41	65	110
5	60.87	1.75	0.5	5.1	75	41	60	105
12	60.96	1.4	0.5	3.0	105	38	70	115
18	61.44	1.3	0.3	3.75	100	36	85	140
24	63.09	1.3	0.3	2.75	90	40	65	110
T.aestivum								
1	55.3	2.3	1.2	5.0	105	40	85	110
5	57.5	2.0	1.2	4.8	105	40	95	115
12	57.0	2.2	1.0	4.7	110	40	80	105
18	57.7	2.2	1.25	4.5	115	39	95	115
24	56.9	2.7	1.5	4.7	80	40	70	100

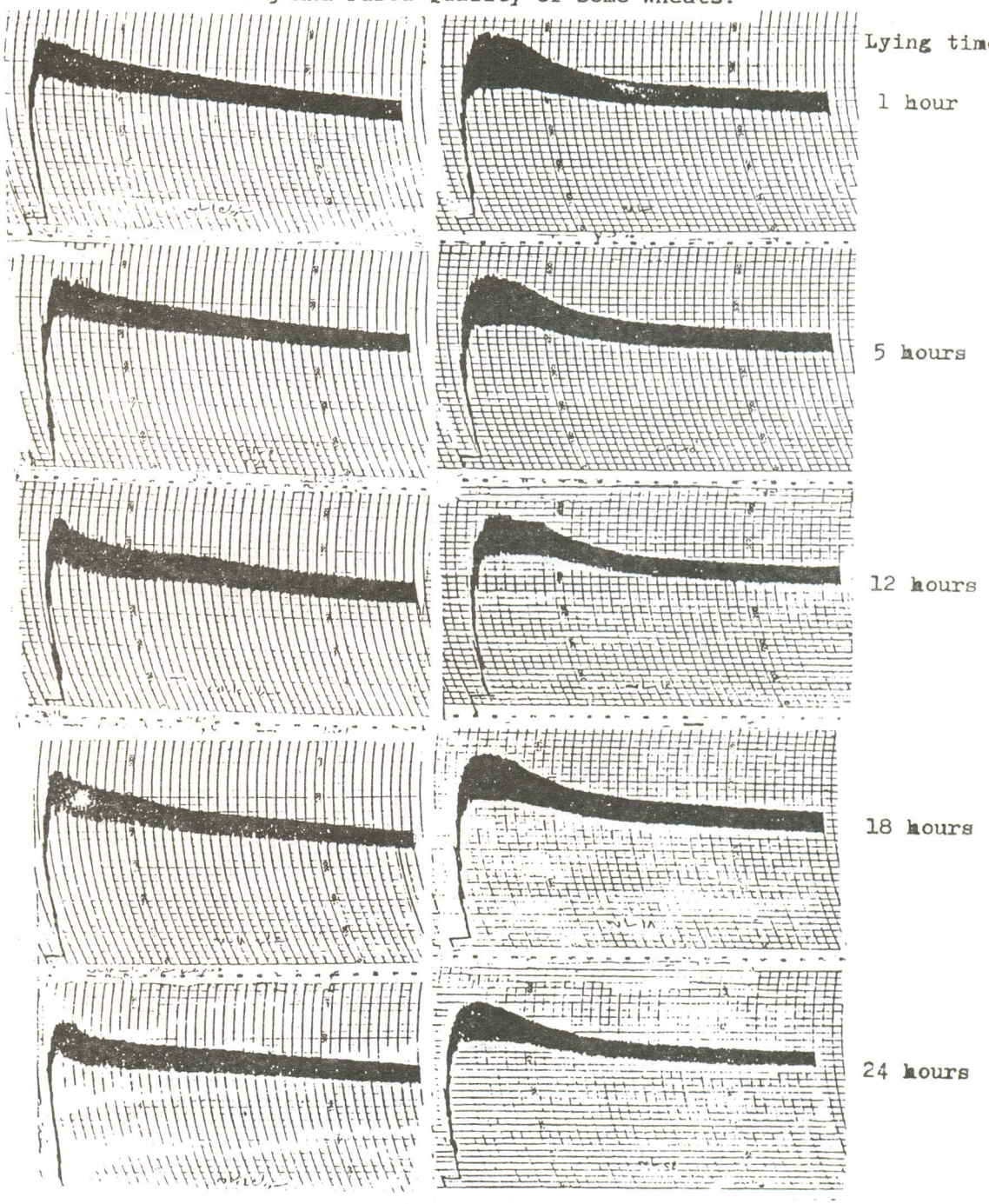

Fig.(1)Effect of conditioning lying time on T. durum and T. aestivum farinogram .

T. durum strok's (5 hrs. conditioning time) and the three imported varieties of semolina (Turkey) are show in table (4). The obtained results indicate that durum strok's was brown and had the highest grade color value while, pasta made from imported semolina was yellow and had the lowest grade color. T. aestivum pasta Amoun and Mataria had brown color and lesser grade value than stroks.

Due to strok's highest pigment loss during processing strok's spaghetti had the lowest pigment content (3.45 P.P.m.)comparing with other durum spaghetties. Irvin(1971) stated that pigment loss during pasta processing is caused by lipoxidase enzymes. Therefore, it could be concluded that lipoxidase activity is higher in strok's than in other durum spaghetties. There is a positive correlation between pigment loss and brownness during pasta processing .This result is in agreement with that of Matsuo et al.,(1982) High lipoxidase activity could be attributed to varietal characteristics (Walsh et al., 1970).high extraction rate (Matsuo et al.,1982) and long conditioning lying time with high moisture content. Storks spaghetti had the highest lysine loss percentage during processing (Table, 4). Lysine loss could be attributed to Millard reaction during pasta drying (Lysine blocking) in addition to some lysine destruction (Manser, 1981). The highest lysin loss in storks pasta could be attributed to its high reducing sugar content and high non protein nitrogen content which accelerate Millard reaction. During storage, advances in Millard reaction takes place and stork's spaghetti becomes browner and duller by time.

Pasta Rheological Property

Data in table (5) and fig (2) show the farinogram of T. aestivum and T. durum flours and semolina under investigation. Semolina samples had the lowest water absorption value. Low water absorption is of great demand for pasta dough property that gives a hemogenous dough mass for macaroni processing. Dough development time was higher in semolina than other flours while,stork's flour had the lowest development time. However, the reduction in dough mixing time is usually associated with weaker gluten (Dexter and Matsuo 1978). Semolina and stork's showed shortest dough stability time and highest dough weakening Amoun had the highest dough stability and the shortest dough weakening. Weaking of the dough (B.U.) is very important factor affecting its suitability for macaroni production. According to Irvin and Anderson (1951), ideal dough should rise to a peak rapidly and should break slowly in the farinogram. Increasing dough weakening would in turn increase dough stability for macaroni production (Morad et al.,1980). Amoun had the highest valorimeter value while, stork's had the lowest. Mataria had weaker gluten due to its low protein content (7.9%). Also, stork's has weaker gluten because of its protein quality and unfavourable milling conditioning which accelerate the enzymatic activity and weaken the dough.

Table (4): Chemical characteristics of spaghetti Macaroni effective factors of colour (on dry basis).

Spaghetti	Appearance	Ash content %	Grade colour Figure	Browning A at 400 nm		Cu content p.p.m.	Alpha Amylase activity (1)	Pigment of (2)			Reducing sugar %	Non N protein %	Available lysine		
				Flour	Pasta			Flour p.p.m.	Pasta p.p.m.	Loss %			Flour %	Pasta %	Loss %
T. aestivium															
"Amoun	Brown	0.46	8.4	0.159	0.113	0.302	16.26	3.16	2.05	35.12	0.27	0.121	0.27	0.22	18.5
Mataria	Bale brown	0.42	4.1	0.130	0.078	0.299	18.80	2.60	1.62	37.69	1.90	0.135	0.25	0.20	20.0
T. Durum															
Roma	yellow	0.73	3.5	0.153	0.103	0.590	16.39	6.70	5.21	22.24	1.08	0.120	0.30	0.24	20.0
Capri	yellow	0.76	3.6	0.145	0.092	0.936	13.10	7.00	5.98	14.57	0.80	0.110	0.30	0.255	18.3
Buitoni	yellow	0.72	3.3	0.150	0.095	0.806	15.26	7.40	5.70	23.00	0.71	0.100	0.30	0.255	18.3
Stork's	Brown	1.05	10.6	0.200	0.135	0.933	19.22	7.10	3.45	51.41	2.89	0.274	0.31	0.23	25.8

(1) Reported on 15% moisture content.

(2) Reported on 12% moisture content.

Table (5): Farinogram of flour and semolina of commercial pasta(1).

Pasta Flour and semolina	Water absorption %	(D.D.T.) Dough development time min.	Arrival time min.	Dough stability min.	Degree of softening after 10 min.	Degree of softening after 20 min	Valorimeter value
T. aestivium							
Flour of Amoun	63.4	2.6	1.6	6.7	55	95	45
Four of Mataria	53.7	1.5	0.7	4.0	90	130	35
T. Durum							
Semolina of Roma	50.8	3.2	1.0	2.4	90	115	37
Semolina of Capri	50.0	3.1	1.0	2.0	90	120	36
Semolina of Buitoni	50.9	3.2	1.3	2.2	90	115	37
Flour of Stork's	62.1	1.2	0.3	2.0	125	165	30

(1) On 14% moisture basis.

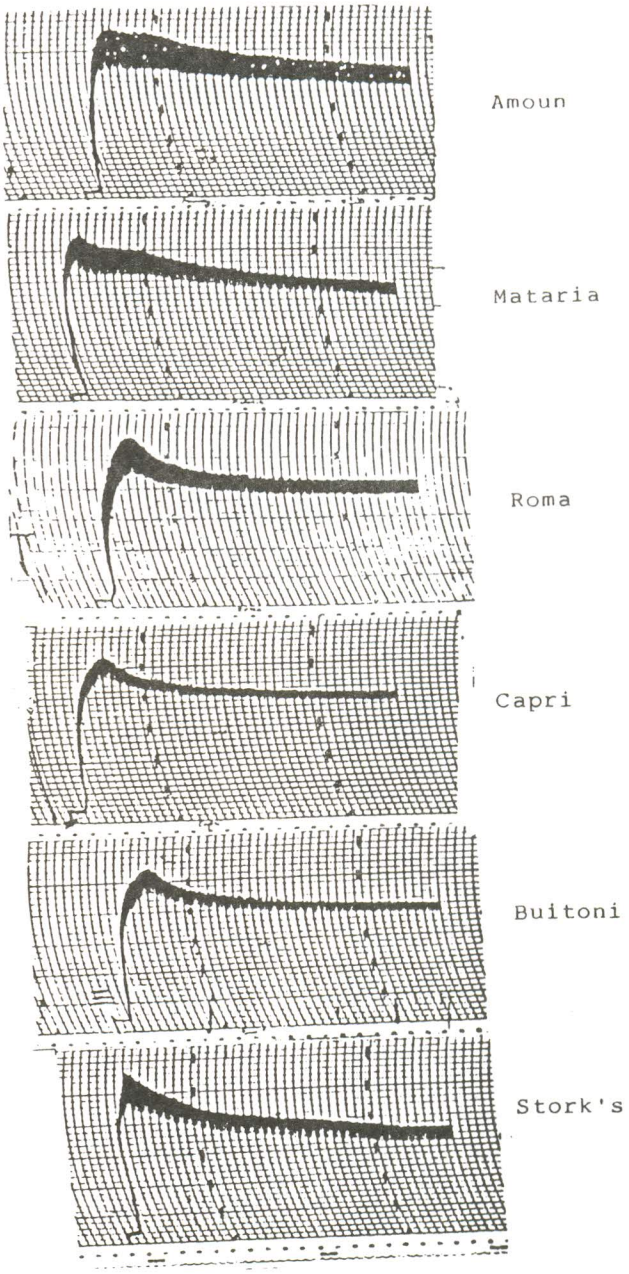

Fig.(2) Farinogram of pasta dough

Table (6): Cooking quality of different commercial macaroni.(on 12% moisture basis).

Macaroni type	Water absorption %	Increasing of weight %	Swelling index %	Cooking loss %
T. aestivium				
Amoun	210	3u1	4.0	8.9
Matalia	200	290	3.5	9.8
T. Durum				
Roma	275	368	4.8	6.7
Capri	292	385	5.1	7.0
Buitoni	268	357	4.6	7.0
Stork's	274	365	4.3	6.8

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Cooking Quality:-

Results present in table (6) show that water absorption, increasing of weight and swelling index for pasta processed from T. aestivum are lower than that from T. durum. Cooking loss (total soluble solids) was higher in T. aestivum than in T. durum. These results are in agreement with those of Anon (1983). It is clear that imported semolina had the greatest increase of weight and higher swelling index. Pomeranz (1978), revealed that cooking loss had reverse correlation with water absorption. Therefore, samples with low amount of total soluble solids, high protein content, slight weaking of gluten properties and high percentage of weight and volume after cooking were of good cooking quality.

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دراسات كيماوية
وتأثير التكييف ونوعية المكرونه لبعض أصناف القمـــــح

منير عبدالعظيم تركى
أحمدراضى عبداللطيف

نادية يحيى عطيه
أحمدالسيدالبردينى

تمت دراسة التركيب الكيماوى وتأثير التكييف لصنف الديورم المصرى ستورك ولصنف قمح عادى استرالى. استخدمت أيضا ثلاثة أصناف من دقيق السيمولينا المستورد (روما - كابرى بيوتينى) بالاضافة الى دقيق ستورك ودقيق نوعين من الاقداح العادية المستوردة لدراسة العوامل التى تؤثر على اللون البنى وانزعيه وصفات الطهى للمكرونه المصنعه .

تميزت حبوب ودقيق الديورم المصرى ستورك بارتفاع نسبة الرماد والالياف والبروتين والسكريات ونشاط انزيم الالفا اميليز . كان أفضل زمن تكييف للديورم المصرى ٥ ساعات بينما كانت ١٢ ساعه لصنف القمح العادى الاسترالى . تميزت المكرونه المصنعه من الديرم المصرى باللون البنى وأعلى قيمة لونيه بينما المكرونه المصنعه من دقيق السيمولينا المستورد كانت صفراء اللون ولها أقل قيمة لونية كذلك تميزت المكرونه المصنعه من الدقيق العادى " أمون ومطريه " باللون البنى الغفيف ودرجة نون أقل من الستورك . يعزى اللون البنى الى الصنف والى وجود النخالة والى نشاط انزيمى وتفاعلات غير انزيميه .

تميزت السيمولينا ودقيق الستورك بأن لهما مدة ثبات قصيرة وأما ضعف العجين فقد أظهر دقيق الستروك أن له أكبر ضعف .

بالنسبة لصفات السلق للمكرونه فقد تبين أن الزيادة فى الوزن والحجم للمكرونة المسلوقة المصنعة من دقيق القمح العادى أقل منها فى حالة المكرونة المصنعه من قمح الديـــــــروم.