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Note on Physical and Chemical Properties of Guar Gum in Some Newly Developed Guar(*Cyamopsis tetragonoloba*L. Taub) Genotypes[1]

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Abstract: This study aimed at determination of the physical and chemical characteristics of guar gum in twenty newly developed guar (*Cyamopsis tetragonoloba* L. Taub) genotypes. For assessment of the physical properties, data were recorded on refractive index, specific rotation, optical density and relative viscosity. The chemical analysis included gum content, pH and sugar profile. The gum content ranged from 23 – 30.33 %, with a 2.08 ratio of mannose to galactose. The relative viscosity ranged from 2055.17 to 3167.9 centipoises, the highest value was detected in Gm22. Moreover, the values of specific rotation, pH, refractive index and optical density of guar gum ranged from43.33°to 81.67°, 6.15 to 7.13, 1.336 to 1.338 and 0.03 – 0.44%, respectively. It was concluded that a wide range of variability exists among the evaluated genotypes in most of the studied characteristics. Such variation can be exploited in breeding programs for improvement of gum quality.

Key words: guar**;** gum, mannose, galactose and physical properties.

Guar (*Cyamopsis tetragonoloba* L.) or cluster bean is cultivated for food, feed and fodder(Sultan *et al*. 2012). It is also a well-known cash crop (Pathak *et al*., 2010) and is termed as a 'non-thirsty crop' in spate irrigation areas. Guar has acquired an economic importance after the discovery of the

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gummy substance(galactomannan) in its seed endosperm.The seed contains about 33 % endosperm and is extremely valued on industrial scale because it contains about 80 % galactomannanin endosperm. Guar richness in its gum has made it one of the most important industrial crops (Pathaket *al*. 2010). Guar gum forms a viscous gel in cold water and is used as an emulsifier, thickener, stabilizer in a wide range of food and industrial application (Marina*et al.* 2007). The objective of this study was to assess the physical and chemical properties in twenty newly developed guar genotypes. These genotypes were developed by classical breeding method for improvement of gum quality. The seeds of these guar genotypes were kindly provided by Dr. Abdel wahab H. Abdalla, Department of Agronomy, Faculty of Agriculture, University of Khartoum.

For the extraction of guar gum, the endosperm of guar seeds were separated as clean as possible from the hull and germ. The hull of guar seed was removed by treating the hull with concentrated H_2SO_4 (10/20, v/w) for about 10 hours to loosen the hull. Then the contents of the beaker were thoroughly washed with distilled water several times for removing the black loosened hull. The contents of the beaker were dried in an oven at 105° C for 20 minutes. After removing the black loosened hull, the white endosperm and yellowish germ were separated by differential selection because of difference in hardness of each constituent. The separated endosperms were ground to fine particle size and stored in polythene bags. The following parameters were then determined on the extracted gum i.e refractive index, specific rotation, optical density, relative viscosity as well as pH value according to AOAC (1994) and carbohydrate profile according to Ucar and Balaban (2003).All tests were carried out using triplicate samples.The recorded data were subjected to analysis of variance described for a completely randomized design (Gomez and Gomez, 2010). Then means were compared following the method of the least significant difference. Computations were performed using Excel version 2007 computer package.

Significant differences ($p \leq 0.05$) were detected among the evaluated guar genotypes in all studied characters (Table 1).Gum content of the seed ranged from 23– 30.33 %, with an overall mean of 27.8 %.The highest value was

recorded in genotype Gm24. These results are in agreement with the findings of Sabah Elkheir *et al.* (2012).The overall mean refractive index was 1.34,a value that is in agreement with that obtained by Taha *et al*. (2012). However, they were higher than those reported by Sabah Elkheir *et al.* (2012) and Eldinary *et al.* (2015). Such discrepancy in the results might be due to the differences in the plant materials used by the different investigators as well as the conditions under which tests were executed. The specific rotation for guar gum ranged from 43.33º– 81.67º, with the highest value recorded in Gm 17. These values are in conformity with the values obtained by Sabah Elkhier (1999) and Sabah Elkheir *et al.* (2012), who indicated a range of +20 to +76º.The relative viscosity ranged from 2055.17–3167.9 CPs. The highest mean gum viscosity was recorded in Gm 22. This result is higher than that obtained by Taha *et al*. (2012),but is in agreement with the values reported by Sabah Elkheir *et al.* (2012). The pH ranged from 6.15–7.13, which is in agreement with the findings of Sabah Elkheir *et al* (2012). However, it was higher than those reported by Taha *et al*. (2012) and Sabah Elkhier (1999).The optical density was between 0.03 and 0.44 %. The obtained results were higher than those reported by Sabah Elkheir *et al.* (2012) and Eldinary *et al.*(2015).

Using HPLC analyses, it was found that the guar gum contains two monosaccharides namely D- galactose and D-mannose. The ratio of mannose to galactose ranged from 1.79 to 2.84, with an overall mean of 2.08. The highest value (2.84) was detected in the genotype Gm 9. This result is in agreement with the findings reported by Badr*et al.* (2014) and Sabah Elkheir *et al.* (2012).

It can be concluded that a wide range of variability exists among the evaluated guar genotypes in most of the studied physical and chemical properties of guar gum. Thus the tested material seems to have a great potential and can be utilized in breeding programs for further improvement of guar gum quality.

Some properties of new guar genotypes

Table 1. Means of the physical and chemical characteristics of guar gum

Genotype	Gum Content	Viscosity	Optical Density	pH	Specific Rotation	Refractive Index	Mannose to Galactose ratio
Gm2	23 i	2075.20 i	0.12 e	7.13 a	76.67 abc	1.3369 d	2.18 b
Gm4	26.83 ij	3022.53 b	0.03 h	6.91 b	46.67 jk	1.3362 e	1.95 c
Gm5	27.83 fg	2471.17 ef	0.23 c	6.97 b	53.33 ghi	1.3369 d	2.15 b
Gm6	29.33 cd	2071.27 i	0.34 b	6.78 c	63.33 ef	1.3379 ab	2.06 c
Gm7	26.33 j	2466.67 ef	0.10 f	6.66 d	58.33 fg	1.3369 d	1.90 c
Gm8	28.83 de	2080.93 i	0.14 e	6.51 e	63.33 ef	1.3376 bc	1.97 c
Gm9	27.17 hi	2055.17 i	0.44 a	6.47 e	68.33 de	1.3382 a	2.84 a
Gm16	26.67 ij	2242.90 g	0.08 g	6.30 fgh	65.00 e	1.3369 d	1.88 c
Gm17	28.5 e	2997.47bc	0.08 g	6.24 hi	81.67 a	1.3379 ab	2.01 c
Gm18	28.67 e	2551.40 e	0.22 c	6.37 f	71.67 cd	1.3379 ab	1.79 d
Gm19	27.67 gh	2461.90 ef	0.21c	6.48 e	78.33 ab	1.3376 bc	1.82 c
Gm21	29.5 bc	2215.53gh	0.09 fg	6.33 f	50.00 ij	1.3369 d	2.14 b
Gm22	28.83 de	3167.90 a	0.08 g	6.30 fgh	53.33 ghi	1.3372 cd	1.85 d
Gm23	29.33 cd	2145.37 hi	0.087 fg	6.21 ij	73.33 bcd	1.3369 d	2.26 b
Gm24	30.33 a	2923.83 c	0.07 g	6.17 ij	48.33 ijk	1.3369 d	2.02 c
Gm29	27.83 fg	2120.27 hi	0.077 g	6.25 ghi	63.33 ef	1.3369 d	2.27 b
Gm31	30 ab	2391.00 f	0.12 e	6.32 fg	56.67 gh	1.3379 ab	2.20 b
Gm34	25.33 k	3161.90 a	0.07 g	6.15 j	48.33 ijk	1.3369 d	2.25 b
L14	24.83 k	2756.90 d	0.14 e	6.30 fgh	43.33 k	1.3369 d	2.07 c
L53	28.33 ef	2501.23 e	0.16 d	6.19 ij	51.67 hij	1.3369 d	1.93 c
Mean	27.758	2494.03	0.1448	6.453	60.75	1.337	2.08
Sd ±	0.5481	93.951	0.0182	0.073	5.696	0.0005	0.24

Means with the same letter within a column are not significantly different at $p \leq 0.05$

REFERENCES

AOAC.(1994). *Official Methods of Analysis of the Association of OfficialAnalytical Chemists*. Vols.I and II, Association of Analytical Chemists, Arlington,USA.

Badr, S. E.;Abdelfattah, M. S.;El-Sayed, S. H.;Abd El-Aziz, A. S. and Sakr, D. M. (2014). Evaluation of anticancer, antimycoplasmalactivities and chemical composition of guar (*Cyamopsis tetragonoloba*) seeds extract. *Research Journal of Pharmaceutical Biology and Chemistry Sci*ences 5(3)**,** 413- 423.

Eldirany, A. A.;MohamedNour, A. A.; Khidir, K. E.; Gadeen, K. A. and Ibrahim, M., M. (2015). Physicochemical and functional properties of four new genotypes of guar gum (*Cyamopsis tetragonoloba L.*).*American Journal of Food Science and Health***1** (2), 43-50.

Gomez, K. P. and Gomez, A. A. (2010). *Statistical Procedures for Agriculture Research* 3rd Ed., John Wiley and Sons Inc., New York, USA.

Marina, N.; Jerez, I. T.; J.ihe, S.; Zhao, P. X.; Dixon, R. A. and May, G. D. (2007). Analysis of cDNA libraries from developing seeds of guar *(Cyamopsis tetragonoba* L. Taub). *BMC. Plant Biology* **7**, 1-12.

Pathak, R.; Singh, S. K.; Singh, M. and Henry, A. (2010). Molecular assessment of genetic diversity in cluster bean (*Cyamopsis tetragonoloba*) genotypes. *Journal of Genet*ics **89**, 243-246.

Sabah Elkhier, M. K. (1999). *Improvement of Yield and Quality of Guar* (*Cyamopsis tetragonoloba*). Ph.D. Thesis, Faculty of Agriculture,University of Khartoum,Sudan.

Sabah Elkheir, M. K.;Abdalla, A. H. and Nouri, S. H. (2012). Quality assessment of guar gum (endosperm) of guar (*Cyamopsis tetragonoloba*). *ISCA. Journal of Biological Science* **1**(1),67-70.

Sultan, M. and Rabbani, M. A.(2012). Phenotypic divergence in guar (*Cyamopsis tetragonoloba*L.) landrace genotypes of Pakistan. *Pakistan Journal of Bot*any **4** (4),203–210.

Taha, K. K.; Elmahi, R. H.; Hassan, E. A.; Ahmed, S. E. and Shyoub, M. H. (2012). Analytical study on three types of gum from Sudan. *Journal of Forest Products Industry***1** (1), 11-16.

Ucar, G. and Balaban, M. (2003). Hydrolysis of polysaccharides with 77% sulfuric acid for quantitative saccharification. *Turkish Agriculture and Forestry***27**,361-365.

الخصائص الفيزيائية والكيميائية لصمغ القوار (*Cyamopsis tetragonoloba* L. Taub) في عشرين طرازآ تم استنباطها حديثآ[2]

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المستخلص: هدفت هذه الدراسة لتحديد الخصائص الفزيائية والكيميائية لصمغ القوار في عشرين طرازآ وراثيا تم استنباطها حديثا. بالنسبة لتقيم الخصائص الفزيائية للقوار تم تسجيل البيانات عن معامل الانكسار، الدوران النوعي، الكثافة الضوئية واللزوجة النسبية، وشمل التحليل الكيمائي محتوي الصمغ والأس الهيدروجيني ومكونات السكر.محتوي الصمغ تراوح بين23- 30.33 %. تقييم صمغ القوار أوضح أن نسبة سكر المانوزللجلاكتوزهي 2.08. قيمة اللزوجة النسبية تراوحت بين 2055.17- CPs3167.9 وقد رصدت أعلى قيمة في الطرزGm22. اضافة لذلك فإن قيم الدوران النوعي والأس الهيدروجيني ومعامل الانكسار والكثافة الضوئية تراوحت بينº43.33- º81.67، 6.15-7.13،1.336-1.338، 0.03-0.44%، على التوالي. خلصت الدراسة الى ان هنالك مدى واسع من التباين بين الطرز الوراثية التي تم تقيمها في معظم الخصائص المدروسة. هذا التباين يمكن إستغلاله في برامج التربية لتحسين جودة الصمغ.

[2] مستلة من اطروحة الدكتوراه للمؤلف الاول؛ جامعة الخرطوم