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Acacia Seyal Gums in Sudan: A review

Sara, S. Awad[1]; Ali, A. Rabah[2]; Hassan, I. Ali[3], Tarig, E. Mahmoud[4]

[1]Industrial Research and Consultancy Center (E-mail: sara_awad77@hotmail.com)
[2]Department of Chemical Engineering, Faculty of Engineering, University of Khartoum (Email:rabahss@hotmail.com)
[3]Kenana Sugar Company limited, Strategic Plannin,(Email:hassan.mofadel@kenana.com)
[4]University of Kordofan(Email:tarigcom@gmail.com)

Abstract: Historically *Acacia seyal* gums in the Sudan is ranking as a second important gum product after *A. senegal* in terms of quantities 10% in average until 2011. Thus the contribution percentages within the last four years (2012-2015) jumped to almost 60% in average. *A. seyal* trees coverage extend in an area of 36,000 square kilometers (3.6 million ha) in a latitude ranging between 10 to 14^0North. The distribution of the *A.seyal* stand is extensively on the clay soil plains where an average rainfall is ranging between 300 to 400 mm. Two infraspecific variants of *A. seyal* widely distributed in Sudan separated on the basis of the presence and absence of the ant-galls and the colour of the bark. Ant-gall and white colored bark are the characteristics of variety *fistula*, while the bark of variety of *seyal* is green or red. Despite the significant contribution of *A. seyal* in the exports market in the Sudan, farmers have slightly a poor knowledge of post-harvest cultural practices of *A. seyal* of which proper methods of storage conditions and gum stacking. Nevertheless, this paper is trying to review the existing research in the areas of pre- and post-harvest cultural practices including tree husbandry, tapping, gum collection, handling and storage. Exudation mechanisms (tapping and natural exudation) are also been highlighted coupled with physical and chemical properties of *A. seyal* (characterization) as well as moisture content, colour, tannins etc., aiming at establishing a clear protocol of the *A. seyal* tree in the Sudan.

Keywords:*Merowe Dam; Specific Water Consumption S.W.C; Routing, Operation Rule Curve; Megawatt*

INTRODUCTION

Acacia Gum is a natural agricultural resource from the Gum Belt region of Africa, i.e. countries geographically ranging from East to West -from Sudan, Somalia, Eritrea and Ethiopia to Chad, Central African Republic, Mali, Niger and further west up to Nigeria, *Senegal* and even Mauritania. Economically speaking, *Acacia* Gum mainly comes from Sudan, Chad and Nigeria.

In Sudan, the most important NWFPs (Non-Wood Forest Products) is Gum Arabic, which exudates from *Acaciasenegal* known as *hashab* or hard gum and *Acaciaseyal* known as *talh* or friable gum. Both species spread naturally in the central belt of the low rainfall savannah where they existed in pure or mixed stands, in the clay plains in the East and sandy soils in the West [1].

Despite the significant contribution of *A. seyal* in the exports market in the Sudan, farmers have slightly a poor knowledge of post-harvest cultural practices of *A. seyal* of which proper methods of storage conditions and gum stacking. Nevertheless, this paper is trying to review the existing research in the areas of pre- and post-harvest cultural practices including tree husbandry, tapping, gum collection, handling and storage. Physical and chemical properties of *A. seyal* (characterization) aiming at establishing a clear protocol of the *seyal* tree in the Sudan.

ACACIA SEYAL TREE AND DISTRIBUTION

Acacia seyal trees are up to 17 m tall in Sudan, with a flat top crown. It has a distinctive smooth powdery bark, from white to greenish yellow or orange red, with a green layer beneath. In some population both red and yellow barked trees can be found. There are two varieties, differing primarily in whether or not pseudo-galls ("ant galls") develop and in bark colour. In *A.*

seyal var. seyal, there are no pseudo-galls and a reddish bark color prevails, although periodic bark exfoliation exposes a pale powdery surface which darkens slowly. In *A. seyalvar.fistula* pseudo-galls are present and the powdery bark typically remains whitish or greenish-yellow.

In general, there are two main varieties of *A. seyal*; variety *seyal* and variety *fistula*. Variety *seyal* is found in both western and eastern Africa and also on the Arabian Peninsula, while variety *fistula* is found in the eastern parts of Africa indicate that variety *seyal* is native to northern-tropical Africa and Egypt. The two varieties can be easily distinguished; variety *seyal* has a greenish-yellow to reddish-brown bark, while variety *fistula* has white to greenish-yellow bark. Figure (1) shows the distribution of *A. seyal* varieties with respect to rainfall. However, *A. seyal* trees are naturally grown in the Sudan till yet no reforestation done by human been [2].

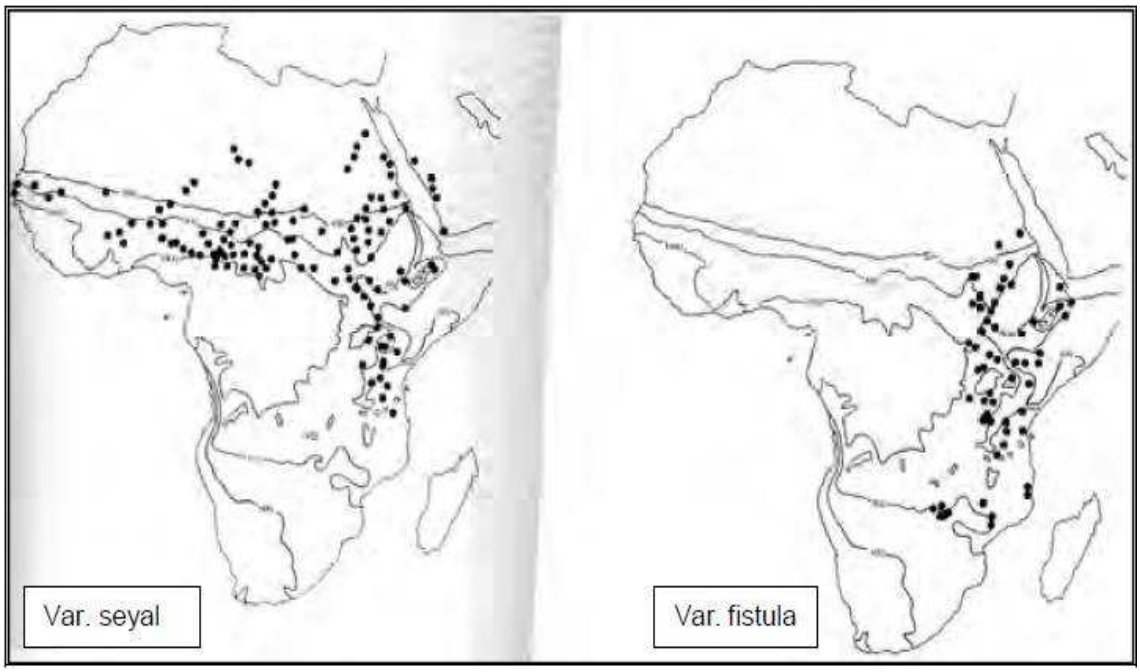

Fig 1: Distribution of *Acaciaseyal* varieties in Africa, with respect to rainfall

ACACIA SEYAL PRE AND POST-HARVEST CULTURAL PRACTICES

Most of the farmers in the sand plains areas have adequate awareness of pre-harvest cultural practices for *A. senegal*. This awareness is due to their vast indigenous knowledge on the traditional farming system additional to the extensive extension held by the Forest National Cooperation (FNC) as a result of a comprehensive research done in the last five decades. The comprehensive research comes up with a clear protocol for a tree husbandry, taping of tree as well as proper way of collecting gums **(Abdel Nour ., 1889)**. However, farmers have slightly a poor knowledge of post-harvest cultural practices of *A. seyal*of which proper methods of storage conditions and gum stacking. Nevertheless, sufficient research has been done in these fields **(Osman, 2002).**For instant, a protocol for a tree of *A. seyal* is not yet been established coupled with poor indigenous knowledge of the local farmers in the clay plains regarding tree husbandry, taping and gum collection. The results of that are inferior quality and poor nodules physical characteristics[4].

Collectors harvest the partially dried gum, and multiple collections up to three times at three-week intervals from the same tree are possible. A yield of 300-7000 g is obtained per tree annually. On the other hand, *A. seyal* is generally collected from natural exudation without tapping. In certain gum sources the natural exudates were noted as being darker in colour compared to gums obtained by tapping **(Anderson & Bridgeman, 1985)**. The method of gum production might be one of the factors causing the difference of colour between *A. senegal*and *A. seyal*. Recently, Fadl and Gebauer reported that the middle stem tapping caused highest *A. seyal* gum exudation. *A. seyal* gum production by tapping might be increased in the future if the problem such as serious stress to the tree is avoided [5]. Tapping is often done by using traditional tools such as axe, Mohfar, Sonki and Makmak shown in figure (2). Using Makmak is highly recommended. Fadl [5] reported that Makmak was the best tool for tapping *A. seyal*. The reason can be seen in the wide edge on the top of the tool, which allows better removal of the bark.

Fig 2:showsMakmak, axe, mohfar, and sonkey (from left to right). Source**:**Fadl and Gebauer 2004

PHYSICAL AND CHEMICAL PROPERTIES OF ACACIA SEYAL

Chemical and physical properties of gum are considered as important characters for the article of commerce, to ensure the identity and purity of gum and avoiding mixing and adulteration.

Moisture content gives an indicator for both purity and a real weight. All results fall within limit specified by JECFA (1990).

The Specific Optical Rotation (S.O.R.) the range of the mean value vary from (+ 51.4 ˚) to (+ 62.8˚).
The range of the mean value of Protein content vary from 0.69 to 0.96 %.The pH ranged from 4.02 to 4.77 for *Acaciaseyal*.

Table 1: The physicochemical properties of *Acaciaseyal*species (Obied, 2012)

No	Moisture	Ash	pH	S.O.R.	Protein content
1	10.04	3.03	4.77	+51.4	0.96
2	10.08	2.12	4.27	+60.5	0.69
3	9.63	1.92	4.31	+62.8	0.83
4	10.04	1.88	4.43	+57.8	0.85
5	9.63	2.1	4.12	+53.9	0.88
6	9.49	2.5	4.31	+59	0.96
7	9.26	2.35	4.02	+56	0.77
8	10.88	2.17	4.46	+62	0.91

Table 2: Cationic composition of *Acaciaseyal*[7],[8]**Abdelrahman, 2008**

Elements	*A. seyal*[1] (ppm)	*A. seyal*[2] (µg/g)	*A. seyal*[3] w/w%	*A. seyal*[3] (µg/g)
Na	6.54 – 49.55	111.054	00048 – 0.03986	4.8125–398.6
K	2400 – 3558	2802.803	0.1808–0.4605	1807.93–4605.01
Ca	9453 – 10145	9417.1973	0.60994–6702.5	6093.81–9165.63
Mg	1224 – 1295	1229.0424	0.136415–0.2159	1364.15–2159
Pb	< 0.84	7.5757	0.000228–0.008261	2.275–82.6125
Cr	0.30 – 0.32	-	0.006449–0.032218	64.4875–378.15
Cu	0.21 – 2.49	-	0.00008–0.000415	0.8–3.9875
Fe	6.51 – 17.06	43.9815	–	–

ACACIA SEYAL CONTRIBUTION IN PRODUCTION AND EXPORTS OF GUMS FROM SUDAN

The production of gum Arabic from both *Acacia*s (*sengal&seyal*) in the Sudan from 1980 until 2014 is shown in Figure(3). Gum Arabic both (*sengal&seyal*) exported from Sudan contributed significantly in the international trade market as indicated in Figure(4). Table (3) illustrates *A. seyal* export contribution from Sudan for the last four years (2012-2015).

Besides the significance of Gum Arabic economic role for the country, it plays an important part in rural life, providing a steady income to rural families especially in dry years when crops fail.

The estimated trend of gum arabic production (quantities in metric ton) is given for 34 years and accordingly the series of these measurements is treated as time series data (more than 25 years for the period extended from 1980 to 2014). The trend estimation is used to make and justify tendency in the data, by relating the quantities of gum arabic to time at which they

occurred. The model shows that the quantities exhibit a zigzagging trend, where an increasing and decreasing manner appears several times, which is statistically distinguished from random behavior. The least square fitting (R^2) shows the residuals of the data obtained for gum arabic quantities after fit. The small value of R^2 indicates that the model explains very small the variability of the response data around its mean.

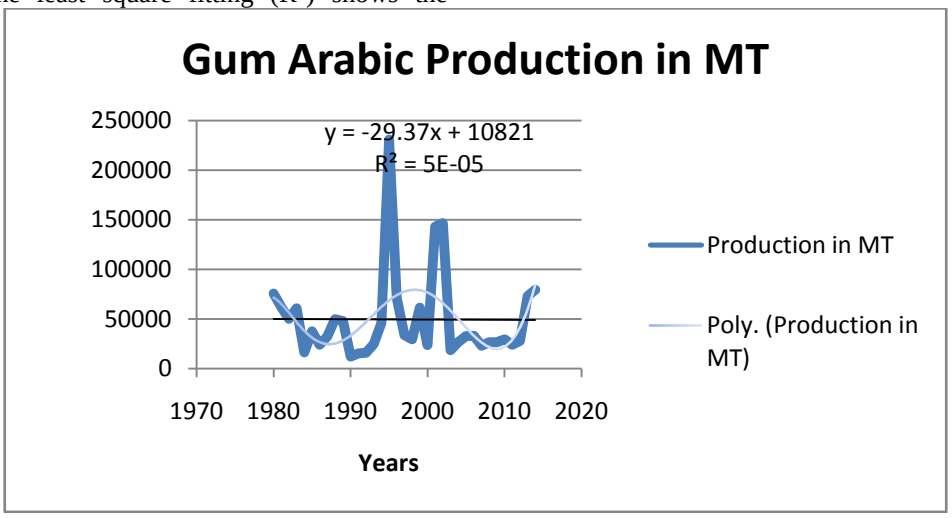

Figure 3: Gum Arabic Production in Sudan 1980 to 2014. Source (Modified from Gum Arabic Co, NFC, Gum Arabic Board)

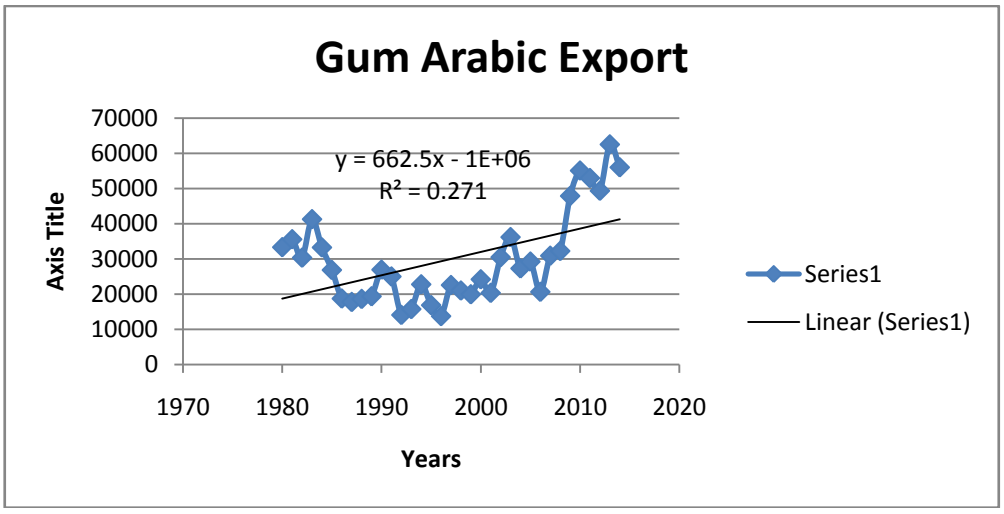

Fig 4: Export quantities of Gum Arabic in MT from Sudan and its share in International Market. Sources (Modified from Gum Arabic Co, Central Bank of Sudan, Gum Arabic Board)

Table 3: Gum *A. seyal* export contribution from Sudan (2012-2015) [6]

Year	Gum *A senegal* (*Hashab*)		Gum *A seyal* (*Talh*a)		Total		Gum *A seyal*export Contribution
	Quantities (MT)	Amount ($)	Quantities (MT)	Amount ($)	Quantities (MT)	Amount ($)	Quantities (%)
2012	25,084	-	24,270	-	49,318	82,693,322	49.2%
2013	28,122	92,104,000	34,890	42,051,000	63,012	134,155,200	55.4%
2014	21,905	62,175,000	37,793	43,999,000	59,698	96,974,000	63.3%
***2015**	10,900	35,149,180	23,141	22,462,820	34,041	57,612,000	68%

*six months

The estimated trend of gum arabic export (quantities in metric ton) is given also for 34 years (1980 to 2014). The model shows that the quantities exhibit an increasing trend over times. The R^2 indicates that the model explains 27% the variability of the response data around its mean.

CONCLUSION AND RECOMMENDATIONS

1. Improving quality on field increases the likelihood of obtaining chemically good gum.
2. Knowledge of *A. seyal* quality supplied helps in the process of targeting market niches or reducing risk of rejection by the buyer.
3. The good quality gum on the field increases the likelihood of obtaining the good quality on the basis of invisible attributes. Hence, collectors should be sensitized to put effort in the respect of the good harvest and post-harvest practices so that they supply good quality gum. Trainings for gum collectors should be regularly conducted as knowledge and awareness creation are probably the main building blocks for quality-oriented production.
4. The sensitization of collectors should be accompanied by price incentives by which the high quality is rewarded by a quality premium.
5. The current study has strengthened the need to understand the role of forest (tree and/or land) management on the quality of the gum. Clear rules of management are needed to counteract the influence of market forces (price) on competition in forests. Forest management is also a pertinent issue as recurrent competitions may be detrimental to the resource and lead to degradation.
6. There is need for concerted effort towards strengthening the producer associations, construction of storage facilities in strategic locations, capacity building, provision information on prices and markets and development of marketing systems.

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