



Tapping Tools for Gum Arabic and Resins Production: A Review Paper

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Abstract: Gum Arabic and resins production is affected by many factors. Some of these factors biotic and others are non-biotic. The most important non-biotic factor is the tapping of the tree. However, tapping should be done properly in a way which does not harm the tree health. The purpose of this paper is to review and document tapping tools for gum Arabic and resins production. The most efficient and recommended tapping tool nowadays is *Sonki* compared with the traditional axe (Farrar). The *Sonki* was developed by the Gum Arabic Research Division (GRD) in Agricultural Research Corporation (ARC) and it was considered as efficient and effective and cheap tapping tool. It could be locally manufactured and easily adopted by the gum tappers in the gum belt of Sudan. It is reported that it is multi-function tool where it could be used for tapping the tree and harvesting the gum. *Sonki* does not record any negative effect on the tree health. On the other hand, it does not show any danger to the producers or the workers. It is worth to mention that it could be easily used by women and teenage. The *Sonki* is socially accepted, economically feasible and environmentally safe. Recently, the *Sonki* was adopted for training by international organizations such as IFAD, FAO, WFP and many other local and national organizations. Accordingly, it is said that it is the best and appropriate tool to be used for tapping *Acacia senegal* trees across gum belt in Sudan. Other tools such as *Mengaf* is widely used for resin production and axe for talha gum production. The review revealed that *Acacia senegal* is tapped by three tools where *Sonki* is the only recommended one. *Acacia seyal* is tapped by four tools, where Axe is the most common one, however, no significant difference recorded between the four in term of productivity. *Acacia polyacantha* is tapped by three tools in which Farrar is the most common.

For resins production, *Boswellia papyrifera* tree is tapped by *Mengaf* while *Sterculia setigera* tree is tapped by both *Mengaf* and *Sumbok*.

Keywords: Gum Production, Resins, *Acacia senegal*, Tapping, Frankincense, Karaya Gum, Sudan, Ethiopia

1. Introduction

Gum Arabic is a strategic sector for the Government of Sudan, generating social, economic and environmental dividends for communities in the region. Sudan is the world's largest producer and exporter of raw Gum Arabic, "with an annual production corresponding to 70% of the world's raw exports" [5]. Kordofan and Darfur states supply more than 75% of hashab gum (*Acacia senegal* gum) in the country and Gum Arabic is an important export product [18]. *Acacia senegal* base agroforestry is a dominant (76%) land use system in Kordofan [22].

Land use system in Kordofan. Gum Arabic is one of the most important trading commodities coming out of Sudan. Around 80% of the global production of Gum Arabic comes from the *Acacia senegal* in Sudan with the second resource being the *Acacia Seyal*, which produces an inferior quality gum [18]. Darfur, Kordofan and Blue Nile states are the predominant producers of Gum Arabic due to geographic location within 'the gum belt', a geographic area running along the Sahel where climate conditions are ideal for the *Acacia* trees [26].

The arabic name of recommended tapping tool for tapping *Acacia senegal* was written in different English spellings and published in different sources, for instance "*Sonki*" in [1, 15], "*sonkey*" [16, 33], "*sunki*" in [2, 10] and "*sounky*" [28] and "*Sonky*" in [31]. Authors have written of this tool according to the Arabic sounds. Tree tapping is a traditional way of producing gum from hashab trees in Sudan. Usually the tapping is done for *Acacia senegal* by using small traditional Axe (*Farrar*) or by using the newly developed tapping tool called *Sonki* [14]. This tool was described [10] as a spear-like blade and has many advantages over the axes: it does not damage the tree; it regulates the width of the bark removed; it enables tapping of branches from any direction, and more trees can be tapped by one person in a shorter period of time, obtaining of pure gum free from impurities, reaching the higher branches that could not be tapped by using the traditional axe, saving time and reducing labor, *Sonki* could be used in gum collection, increasing the productive age for the

tree [10]. The tapping tool "*Sonki*" or "Bayonet" [21] cm in length and weighing 0.25-0.50 Kg is used for tapping *Acacia senegal* [11]. *Sonki* (Figure 1) is advanced tapping tool, which was developed by the Gum Research Division in Elobeid, Sudan for tapping *Acacia senegal* tree, while the axe is the traditional tool for tapping the gum Arabic trees [16]. The *Sonki* development referred to the honor of Mr. Vidal Hall in 1961 as the first one to innovated new tapping tool for gum production [34]. The *Sonki* described as a hand tool and characterized as safer, easier and quicker to use as well as being less injurious to the tree than axes. Its long arm helps to tap branches further up the tree and the taper avoids scratches [21]. It has a metal head fixed to a long wooden handle. The pointed end of the head is pushed tangentially into the stem so as to penetrate just below the bark, and then pulled up so as to strip a small length of bark longitudinally from the wood which involves tapping of gum Arabic trees [25]. It was also described as a specially designed tool with a pointed metal head [32]. The *Sonki* tool is composed mainly of an iron part about 20cm long with a 3cm width, sharp pointed apex pushed during tapping between the bark and inner cambium, a hook for peeling off the bark and a wooden handle of about 2.5m long. This tool proved to be more efficient and causes less damage to the tree [15]. Sudan has long experience in tapping with the *Sonki*. In Ethiopia, tapping of *Acacia senegal* is done with a specially designed axe and special tool "*Sonki*". Trees are tapped to give strips of relatively similar depth, width and length [7]. The Ethiopian research acknowledged Sudan position in gum production and Sudanese experience in tapping. The purpose of this paper is to review and document tapping tools for gum Arabic and resins production.

2. The *Sonki* and Its Importance in Tapping

2.1. Technical Specifications Required

Gum tapping tool (*Sonki*) is used for tapping gum producing trees e.g. *Acacia Senegal* and *Acacia polyacantha*.

1.0.	Technical Specifications: General	
1.1	Hashab tapping tool (<i>Sonki</i>) made of metal extended with wooden handle	
1.2	Gum trees tapped as described operation (pushing, turning and pulling (PTP))	
1.3	Dimensions	Length: 20 cm with sharp end apex (1 cm).
1.4		Width: 2.5 -3.0 cm.
1.5		Height: 2.5 m.
1.6	Net weight: 0. 25-0.50	
1.7	Capacity of the one tree tapping: Approx. 5-10 min	
1.8	Has no risk when properly fixed	
1.9	Easy to be used by all age gradation and women	

1.10	Access to all branches of the tree when tapping and gum collection
1.11	Touch and simply fixed on the tree branch, insert between the tree bark and the wood of the tree. Then push caring to the length of 5 cm, turn to the right and pull caring. The length of the separated bark should not exceed 20-25 cm.
1.12	For collection, send the tool to the gum and touch it. Hit the gum carefully and receive it in the container you handle.
2.0	Technical Specifications: Construction
2.1	Gum tapping tool (<i>Sonki</i>) made of metal to be fabricated in metal.
2.2	The extended wooden part is preferred to be of bamboo or any other similar straight stick
5	The wooden stick must be connected and fixed to metal part using a nail
3.0	Technical Specifications: Marking
	The Gum tapping tool (<i>Sonki</i>) should be clearly and indelibly marked with the following:
3.1	Sharped apex
3.2	Model
4.0	Technical Specifications: Preservative treatment
4.1	The hashab tapping tool (<i>Sonki</i>) should not to be painted
4.2	If they are to be shipped by sea, then they should also be greased or individually wrapped in a rust inhibiting covering.
4.3	They must also be packed in strong cardboard or wooden boxes.

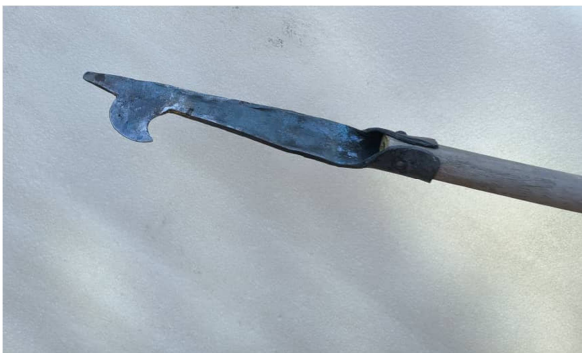


Figure 1. The innovated tapping tool by ARC, Sudan for gum production from *Acacia senegal* tree (Photo authenticated: Muneer).



Figure 4. Using Farrar for tapping the tree by gum arabic producer.



Figure 2. Traditional tapping tool for gum production from *Acacia senegal* tree (Photo authenticated: Muneer).



Figure 3. Using Sonki for tapping the tree by gum arabic producer (Photo authenticated: Muneer).

Note: No technical specifications of other tapping tools documented because no data available was found

2.2. Tapping Process for Gum Production

Gum tapping is the traditional way of producing gum in Sudan. Usually the tapping is done for *A. senegal* (gum arabic tree) by using small Axe (*Farrar*) as showed in Figure 2 - or by using the developed new hand tool called *Sonki* as bared (Figure 1) [14]. The *Sonki* is driven under the bark of the tree without penetrating the wood between the outer bark and inner cambium (IIED and IES, 1989) [24]. A strip of bark (30 - 40 cm) is then removed causing wounds which stimulate gum exudation [9]. The wound resulting from removal of the bark of the tree exposes the inner bark and the cambium of the tree to the external environment (light and wind) and hence the gum exudes cover the wound and thus the gum Arabic is formed.

Tapping of the gum Arabic tree is traditionally done by axe, as described by [9] a light stroke paralld to the side of the branch is made such that the blade is pushed between the outer bark and inner cambium, the blade is then pushed upwards and down words, and then the bark is pulled until it is peeled off into two strips 30-40 cm long or more. The disadvantage of the axe in that it can, if used by an inexperienced tapper, result in damaging the wood, hence weakening the tree and making

it more susceptible to attack by insect, which may kill the tree [8].

The gum Arabic Research Program at El-Obeid Research Station developed an alternative tapping tool. The tool is composed mainly of an iron part of about 20 cm long with a sharp pointed apex (3 cm long) with a tool handle of 2.5 m. This tool is known as *Sonki* which was proved to be less damaging to the tree compared with the traditional axe.

Tapping begins when the trees begin to shed their leaves. A specially designed tool with a pointed metal head is pushed tangentially into the stem or branch so as to penetrate just below the bark, and then pulled up so as to strip a small length of bark longitudinally from the wood [32]. The *Sonki* is driven under the bark of the tree without penetrating the wood between the outer bark and inner cambium [24]. A strip of bark (30–40 cm) is then removed causing wounds which stimulate gum exudation [9]. It was found that to induce production of gum, the bark of the branches is partly stripped off so that the exudate appears and can be collected.

The traditional Axe (*Farrar*) is usually used for tapping the tree before innovation of the *Sonki* tool, but a more sophisticated tool available now is consisting of a blade fixed to the end of a long handle [20]. In each tree, two branches were selected randomly and tapped with a sharp knife locally known as *Sonki* (20 cm long and 5 cm wide with a 3 m long wooden handle). Tapping removes only the outer bark without injuring the cambium. Tapping was carried out at two intervals, the first tapping immediately after the rainy season (November) and the second tapping in summer (February) [31]. Tapping is done when the tree is 4 to 5 years old, the trees are matured enough to be tapped for Gum production [30]. Tapping is usually done after the rainy season starting in October to mid of November. A special tool or knife is used to tape the trees for the gum. The knife is “r” shaped. It has a sharp blade at the tip to cut through the bark, then the sharp hook-like portion is used to tear the bark. Usually the knife head is attached to a long wooden handle so that even the highest branches of the tree can be reached. 1. Wooden handle 2. Metallic hold 3. Sharp hook portion for peeling of the bark strips vertically upward. Any branch averaged 3cm diameter can be tapped. Tapping then commences with the following procedure.

- 1) Place the tip of the straight edge of the knife against the bark of the branch.
- 2) Push the blade to cut through the bark to separate it from the wood. Some people call this step “slashing”.
- 3) With the hook – like portion of the knife, twist the blade away from the branch so that the hook can hold the bark;
- 4) Pull vertically upwards, hooking the bark, so that the bark torn 1 – 3cm wide (depending on the thickness of the branch) – is pulled for a distance of 40 to 50cm. This job is (should be) without such damage to the wood of the tree;
- 5) Repeat the process above on the same branch in several places, and on as many branches as possible to obtain the maximum yield of gum from the tree;
- 6) Leave the tree for a recession period of 30 to 40 days.

During this period, the plant oozes out some water sap (latex) that coagulates to form large waxy crystalline balls.

- 7) It is advisable to tap on one side of the branch each year and alternate with the opposite side the following year to enhance sustained yield from the tree. Acacia gum which exudes from natural cracks on the stem or any crack created by borers should be collected. Such gums are easily distinguishable from other gum as they are of the best quality being free of bark cuts during formal tapping [30].

Tapping of the trees is being done by making one incision on one selected branch and one incision on the main stem using the *Sonki*. The incision had a length of 10-15 cm and a width of 3 cm [35]. The gum is produced from the stems and branches of *Acacia senegal* tree (4-15 years old) by a biosynthesis process (gummosis), when subjected to stress conditions such as drought, poor soil or wounding (i.e tapping; removal of the section of the bark with *Sonki* tool without damaging the tree) [12].

Another tool that is used is called a makmak (Figure 7), which is also used for tapping other gum producing trees. A Makmak, weighing 0.50-0.75 kg with a 15 cm blade with a 7-10 cm sharp edge, is designed for tapping gum trees, for example *Acacia seyal*, by pushing the blade upward into the bark [27].

2.3. Tapping process for Resin Production

Tapping of *Boswellia papyrifera* usually starts in October with a cut removing a strip of bark 2 cm in width and 3 cm in length – using a special tool named “*Mengaf*”. The *Mengaf* has a steel, sharp blade 2 cm in width and 4 cm in length, tapering back and inserted into a wooden handle (Figure 7). The number of tapping points or wounds depends on the size of the tree, usually ranging between nine points for the large trees, six for medium and three for the smaller trees. After the first tapping the wound turns red and can be seen from a distance as a blood colored spot against the background of the yellow paper bark (Figure 8). The tapping of the trees is repeated four times and is usually done at between 15 and 30 days intervals. Collection of resin starts after 30–35 days and extends up to the end of June [1].

Gum karaya, *Sterculia* gum, is the dried exudates obtained from the stem and branches of *Sterculia* tree. *Sterculia setigera* trees are tapped by making incisions using an axe. The gum is collected after tapping or blazing the tree or as natural exudates. *Mengaf* and *Sumbok* were also under tested for tapping *Sterculia setigera* trees [4].

2.4. Gum and Resins Yield

Tapping of the gum tree generally starts when the trees are 3-7 years old with a height of about 1.2-3.7 m and diameter of 5 cm. However, the trees from coppice are tapped at the age of 3-4 years, while trees from seedling are tapped at the age of 5 years. In addition, the trees grown naturally are tapped at the age of 6-7 years old. Gum yield varies considerably with

variation in the genetically make-up of the tree, its environment and management practices such as tapping methods and intensity of tapping [9]. The same author cited variable gum yield figures ranging from 0.1-2 kg/ tree/ year as reported by different authors [9, 17, 29]. Effect of time and intensity of tapping (the number of branches tapped per tree) were investigated, they showed that earlier tapping as in mind October significantly increases gum yield [11]. The mean yield was only 7.1-8.8 kg/tree/ year in late tapping e.g. 30th November and 15th December, respectively. The gum Arabic research programme at El-Obeid Research Station recommended that tapping the minimum number of branches per tree is necessary for sustaining yield without weakening the tree.

Gum exudation occurs after cutting the bark of the tree by a sharp tool locally known as “*Sonki*” or sometime by axe. The first collection of gum is started after 40 days from the tapping. Consecutive pickings are made every 10-15days reaching up to seven pickings [21]. Usually the gum nodules are picked from the stem or branches by using the tapping tool in case of nodules not accessible by hand. The maximum total yield was obtained by the mid or end of February and is obtained from the second to fourth picking [11].

It was estimated that the productive life span of the tree as 20-25 years, in which it is supposed to reach its full maturity [29, 9]. However, the latter author has also reported on cases where the tree reaches over 40 years of age and still capable of gum production. It was reported that most of collection of gum arabic is from natural stands [3]. The yield from these stands is low because of the effect of many factors namely rainfall, grass fires, insect, and soil type. Annual yields from young trees may range from 188 to 2856 g (avg. 900 g), from older trees or 379 to 6754 g (avg. 2,000g) from younger trees [29].

There were significant ($P \leq 0.01$) differences tapping tools between the two tapping tools for *Boswellia papyrifera* trees. The highest resin production 643 g per tree was obtained when the trees were tapped by using *Mengaf*. Trees tapped by *Sonki* produced only 325 g per tree. Tapping by the *Mengaf* tool gave a total yield nearly twice that for the *Sonki* tool. In Ethiopia the resin yield range between 0.5 and 1.0 kg/tree/year [1].

2.5. Tapping Different Trees with Sonki

When testing tapping tools for frankincense production, the author [16] stated that the *Sonki* was originally developed by the Agricultural Research Corporation for tapping *Acacia senegal*, they compared it to *Mengaf* (Figure 7) and mentioned that it appears to be less effective than the *Mengaf*, perhaps due to the difference in the bark of the trees. They added that Today, *Sonki* is commonly used by tappers in Kordofan for hashab gum production. However, due to the different bark of *A. seyal* var. *seyal* compared to *A. senegal*, the *Sonki* is not suitable for tapping *A. seyal* var. *seyal* [1] pointed that *Mengaf* tool is used for tapping *Boswellia papyrifera* and *Sonki* tool is used for tapping *Acacia senegal*.



Figure 5. Using axe for tapping *Acacia seyal* trees (Photo authenticated: Muneer).



Figure 6. Gum nodules exudates after tapping *Acacia seyal* trees (Photo authenticated: Muneer).



Figure 7. *Mengaf* tapping tool for *Boswellia papyrifera* trees (Photo authenticated: Muneer).



Figure 8. The way of using *mengaf* tool for tapping *Boswellia papyrifera* trees (Photo authenticated: Muneer).



Figure 9. Training for gum tappers in North Darfur State for using the *Sonki* tool for gum tapping and collection from *Acacia senegal* trees (Photo authenticated: Kamal).



Figure 10. Sumbok tapping tool for *Sterculia setigera* trees (Photo authenticated: Mohammed).

2.6. Benefits of Using *Sonki*

Sonki save time and labor cost and reported as an efficient tool for gum tapping [3]. They concluded that the effective labor could be able to tap up to 300 trees per day when using *Sonki* and (30-50) trees per day in the case of traditional axe. The *Sonki* was also tested on *Acacia seyal*, the results showed no significant differences between the tested tools [27, 33]. Due to the different bark of *A. seyal* var. *seyal* compared to *A. senegal*, the *Sonki* is not suitable for tapping *A. seyal* var. *seyal*. *A. senegal* trees tapped with the *Sonki* produced significantly more gum yield than those tapped with the traditional axe [16]. This Tool can be used to improve gum Arabic production in clay soil and hence increase households' income in rural communities [15]. Agriculture Research Corporation (ARC) of Sudan reported that tapping increases yield of gum arabic by 47-60% and this report deviate from the results of present study, which have established that tapping of *A. senegal* trees increases gum arabic yield by more than 77.42% [33]. It was reported that in Darfur in the past, producers used traditional axe (Farrar) in the hashab tapping, but after the intervention of the Repro-project and training them on the use of the *Sonki* and its benefits, producers resorted to using the *Sonki* instead of Farrar in the tapping operations. They mentioned that the use of the *Sonki* is easier and more effective than the use of Farrar, and that the *Sonki* helps the producers to reach the far and high branches of the tree which cannot be reached when using the *Farrar* [22]. The *Sonki* was also used for tapping

Acacia polyacantha tree and recorded high productivity [23].

3. Importance of *Sonki* in Climate Change Adaptation

Changes in climate system affect the development processes particularly rural area [6]. It means any change in climate over a time, weather due to natural variability or a result of human activates. It has become a major concern to those whom working in the field of Gum Arabic production. Gum Arabic taping tool do not stand in isolation of the value chain or the socio-economic circumstance of intended adoptees, therefore there is need to sustain Hashab tree and make its resiliencies to climate change this because using of current local tapping tool hurt the tree and endangering this species. Adoption of *Sonki* as recommended gum tapping tool is a slow process, multiple practices/technologies will likely be much more effective than any one new practice/technology (a farmer may be able to improve taping practices, technique/timing, collection practices, in field harvesting techniques and post-harvest management practices.

Farmers are generally quite flexible and do actually adapt to certain changes [36]. Adoptions of farm technologies influencing by many factors may including those are specific to the technology, specific to the households, prevailing policy and institution within which the technology is being disseminated, given this maze of factors, information regarding the potential adoptability (high, medium or low potentials) and "suitability maps" of technologies in required. Planning of the next tapping season depends on the past results tapping practices and the objectives farmers want to reach [19], this will provide a decision-support and bridge this gap by providing information about approaches and methods so that farmers and investors can make informed decision for better development efforts appropriately [13].

In conclusion, factors outside of the technology itself such as land holding, tenure system, the availability to ready markets to sell the surplus products of the improved technology may truncate initial enthusiasm for new technologies. Consequently, adoption of new technologies is a complex process and it should be looking at adoption as a system in which every part of the system can be improve.

4. Conclusion and Recommendations

4.1. Conclusion

It is concluded that about 95% of the *Sonki* users stated that it is a good tool, save time, efficient, relevant to the tapping practice and functionable. It was stated also the *Sonki* can be used for both tapping and collection. Moreover, women and teenagers could also use it feasible. *Sonki* never recorded any damage to the trees compared with axe. Some producers mentioned that using *Sonki* increased the gum production. This tool is characterized by light weight, cheap in price and easy to access high branch. On the other hand, about 5% of the producers who experienced *Sonki* stated that the *Sonki* they

owned has some disadvantages. They pointed to the thickness of metal part and not available in their areas. They could not use it because they were not well trained on how to use. They did not adopt it because if they use it they have to use the axe so as to prune the small lateral branches. Producers though the tree distribute the gum material in its small lateral branches. To sum up, there is agreement multi-benefits and multi-uses of the *Sonki*. Accordingly, the Institute of Gum Arabic Research and Desertification Studies at University of Kordofan annually exerted efforts to conduct training in gum belt to increase adoption of the *Sonki* in tapping and collection of the gum from the trees. IGARDS associated hand with FNC and ARC to cover all gum belt with this innovated tool through extension and training. It is worth to mention that *Sonki*, *makmak*, *axe* and *mengaf* were all tested for production of gum from *Acacia seyal* however, no significant results were recorded between all of them. To sum up *Acacia senegal* was tested by three tapping tools (*Sonki*, *Farrar* and *Makmak*) where *Sonki* is the only recommended one. *Acacia seyal* was tested by four tapping tools (*Sonki*, *Axe*, *Makmak* and *Mengaf*) where *axe* is the most common one, however, no significant difference recorded between four of them in term of productivity. *Acacia polyacantha* was tapped by three tools (*Sonki*, *Farrar* and *Makmak*) in which *Farrar* is the most common one and finally *Boswellia papyrifera* tree is only tapped by *Mengaf* only.

4.2. Recommendations

Based on the review, it is better to use the term “*Sonki*” for this innovated tool since the name was derived from Arabic word. The authors recommended this innovated tool for tapping and picking the gum from *Acacia senegal* tree. It is also recommended to study and assess the adoption rate of *Sonki* in areas of intervention. This current *Sonki* should be developed and modified or another new tool should be innovated to act as multi-purpose tool for sustainable production of gum Arabic. Further and advance research using innovated tools is recommended. For resins production, the current tools need in-depth tests and modifications to the best.

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