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Sapping of Oil Palm (*Eleaeis guineensis, Jacq.*) in the Rain Forest Region of West Africa

Saftgewinnung der Ölpalme (*Eleaeis guineensis, Jacq.*) in der Regenwaldzone Westafrikas.

By Sam K. Essiamah[1]

1 Introduction

In West Africa palms are a conspicuous component of rain forest. Their importance for the structure of the rain forest is usually regarded as very high. As producers of wood, palms are less important because of their anatomical structure, for they have no vascular cambium and therefore produce no real wood. The palms, and especially oil palm (*Eleaeis guineensis Jacq.*), play an important and diverse role in the lives of the inhabitants. Their products, often termed „minor forest products", are very important for the local economy and their value per unit area exceeds, in some cases, the value of timber production.

Since time immemorial, the remarkable fact that palms produce a sugary sap when wounded has been known to people living in tropical forest areas all over the world. In West Africa the usual sources of sap are oil palm and the raffia palm (*Raphia hookeri*, Mann and Wendl). The oil palm will be looked at in more detail here since it is economically the most important. Palm wine is one of the numerous products of the oil palm which is made from the delicious sugar-rich sap, and is obtained by wounding the stem tissues. In West Africa, and particularly in Ghana, the palm wine is sapped from felled trees.

This paper briefly reviews and discusses the methods used in sapping oil palm, source of the palm sap and the danger of destroying palm trees by inefficient and uncontrolled sapping methods in the forest societies of West Africa. Accordingly, emphasis is laid on the need to find new suitable methods of sapping, leaving the tree intact. One such

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method is being developed at the Institute of Forest Botany, University of Göttingen, whose intermediate result is reported here. This is particularly timely, since the world has become conscious of the fact that tropical rain forests are vanishing at an alarming rate and with them immense natural reserves of both plant and animal species. The success of such a research would also improve the health and living standard of West Africans who depend on palm trees.

2. The significance of the oil palm *(Eleaeis guineensis Jacq.)*:

The oil palm (Fig. 1) may be called the „bread tree" of West Africa because of its numerous uses. Fig. 2 shows its distribution in West Africa.

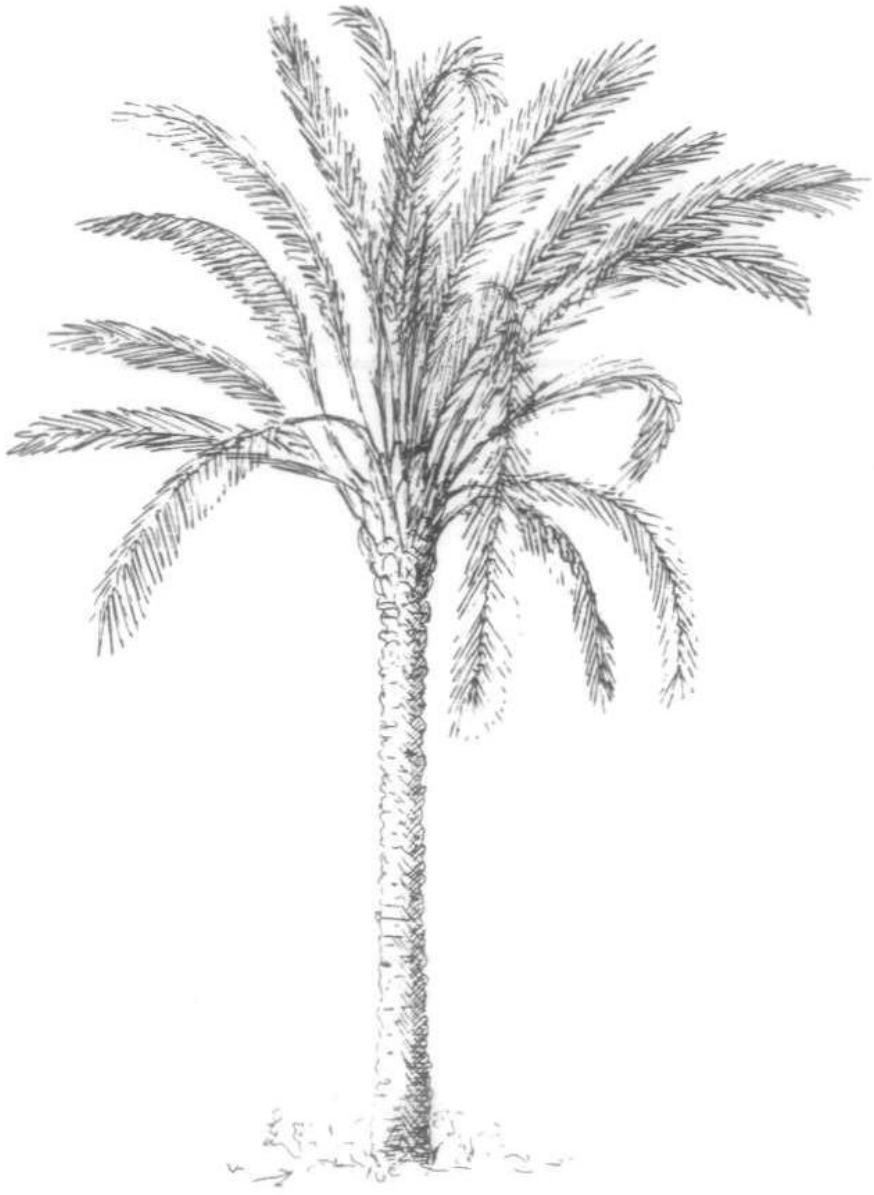

Fig. 1: Oil Palm Tree *Eleaeis guineensis* (Source: ESSIAMAH, 1983).

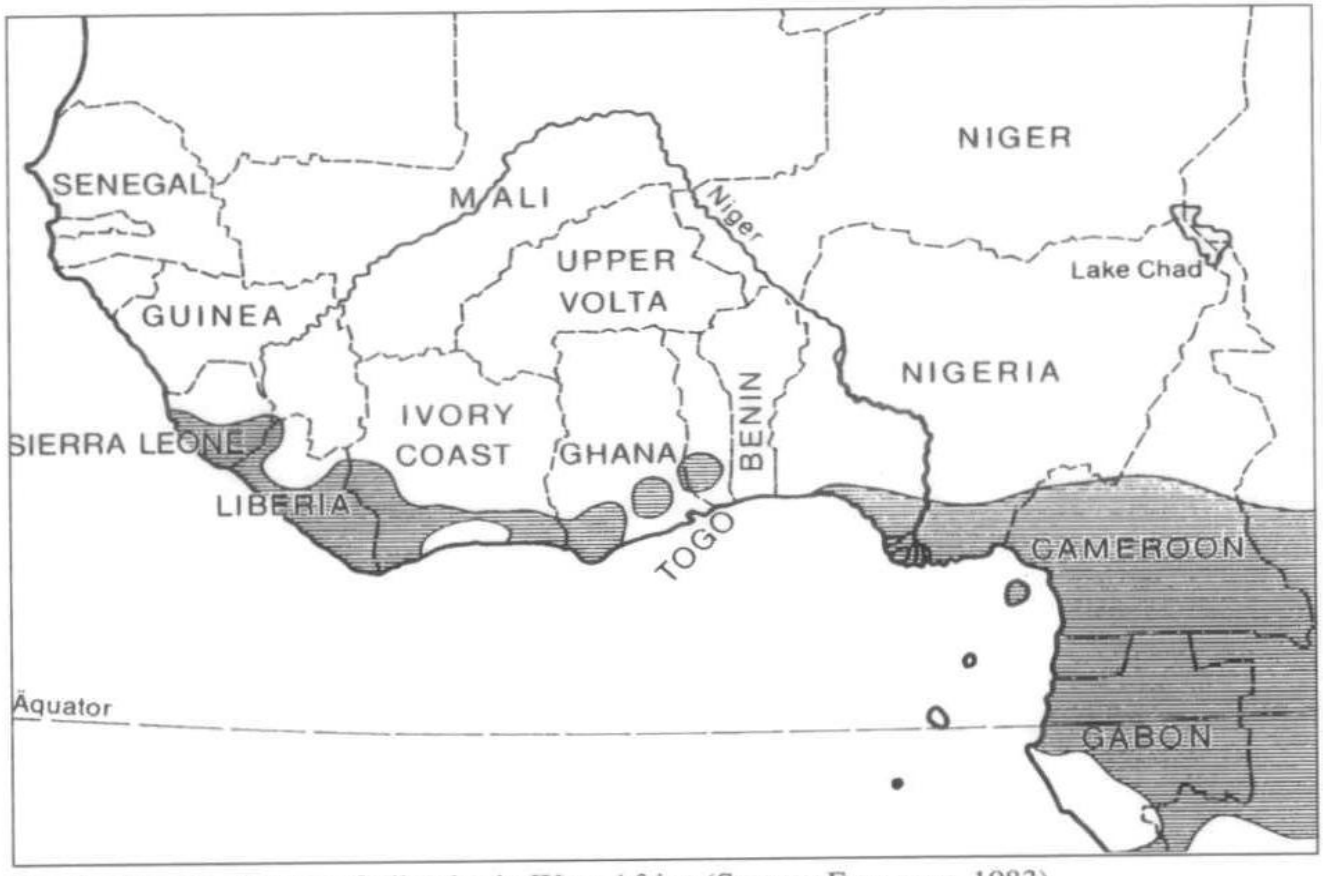

Fig. 2: The distribution of oil palm in West Africa (Source: ESSIAMAH, 1983).

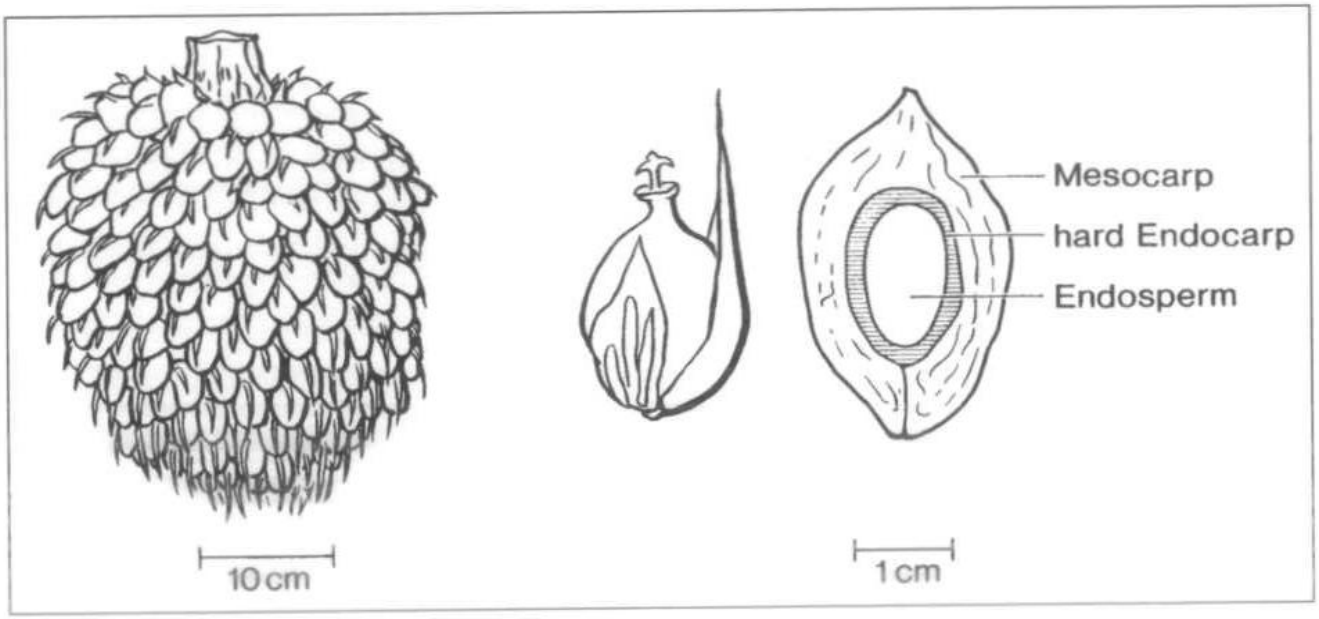

Fig. 3: Oil palm. (from left to right): a female inflorescence, a simple young fruit and an oil palm fruit cut longitudinally, with the soft-bearing mesocarp, hard endocarp and seed endosperm rich in oil. (Source: ESSIAMAH, 1983).

Apart from the widespread use of its fruits for making palm soup, palm oil is extracted from the fibrous mesocarp of the ripe fruits and kernel oil from pressed seeds (Fig. 3).

Palm oil is used for culinary purposes, but serves also for manufacturing soap, cosmetics, margarine and dyes. Pressed oil cake from the seeds is a valuable protein-rich livestock feed. The leaves of the oil palm are used for building, for fencing, and for weaving baskets and mats. The midrib of the feather-shaped leaves is used for brooms. In addition, dried leaves as well as dried fibres from the mesocarp after oil extraction are excellent fuel. Local blacksmiths also use the shell as fuel (ANONYM, 1988). The stem can be used for bridge building, and also as a substrate for growing edible fungi (*Pleurotus spp.*). The palm cabbage which is the soft tissue around the apical bud is an excellent vegetable.

A unique feature of the West African countries is the making of sweet wine from the tapped sap. Not only is palm wine widely enjoyed, but it can be distilled and made into high-quality alcohols (s. distillation of palm wine). Traditionally the palm sap is obtained from felled oil palms just after the fruits have set. In what follows the methods and the attendant damage are described.

3 Traditional methods of obtaining palm sap

3.1 From the inflorescence:

By this method, the inflorescence is cut and the sap flowing from the stem is collected in vessels. This method is practiced on oil palm trees especially by the Jorubas in Nigeria. In this case the leaf subtending an immature male inflorescence is removed to obtain access to the inflorescence enclosed in its spathes. A piece of the front spathe is removed and a cut (6 cm deep) is made in the main stem of the spadix. A new slice is taken daily until the sap begins to flow. A funnel of small bamboo (16 cm long and 2 cm in diameter) is inserted in the cut in such a position that the sap flows into calabashes (vessels). Ropes are used to tie the vessels to the tree and loosen anytime the wine is collected. The wine is collected morning and evening and a new slice taken at each collection.

3.2 From the upper stem:

By this method of collecting the sap a number of leaves are cut off, and the exudate pouring from the pierced stem is caught in jugs hung upon it. This method is employed in West Africa predominantly on *Raphia*, and in some parts (e.g., Igbos in Nigeria) on oil palm. Here several leaves are cut from the side of the stem to be sapped. A rectangular hole (8 cm x 5-10 cm) is cut in the stem to a depth of about 30 cm or more according to the size of the palm tree. A suction-pipe made of bamboo is used to collect the sap into a jug hung on the stem (Fig. 4a). Due to the high intensity of sap flow, the tapper must thrice a day climb the tree to collect the sap. Each time he has to cut away a thin layer of tissue from the wound surface downwards the stem. The length of the rectangular hole can thus extend to 30 cm or more according to the duration of sap flow (Fig. 4b). Unfortunately the palms also die two to three weeks after being sapped.

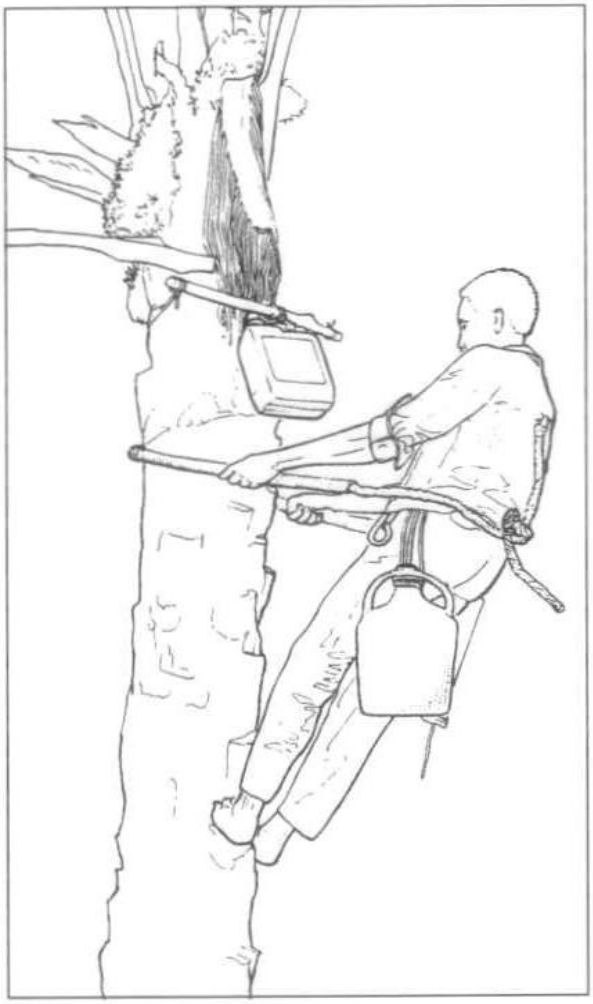

Fig. 4a: A taper collecting oil palm sap.

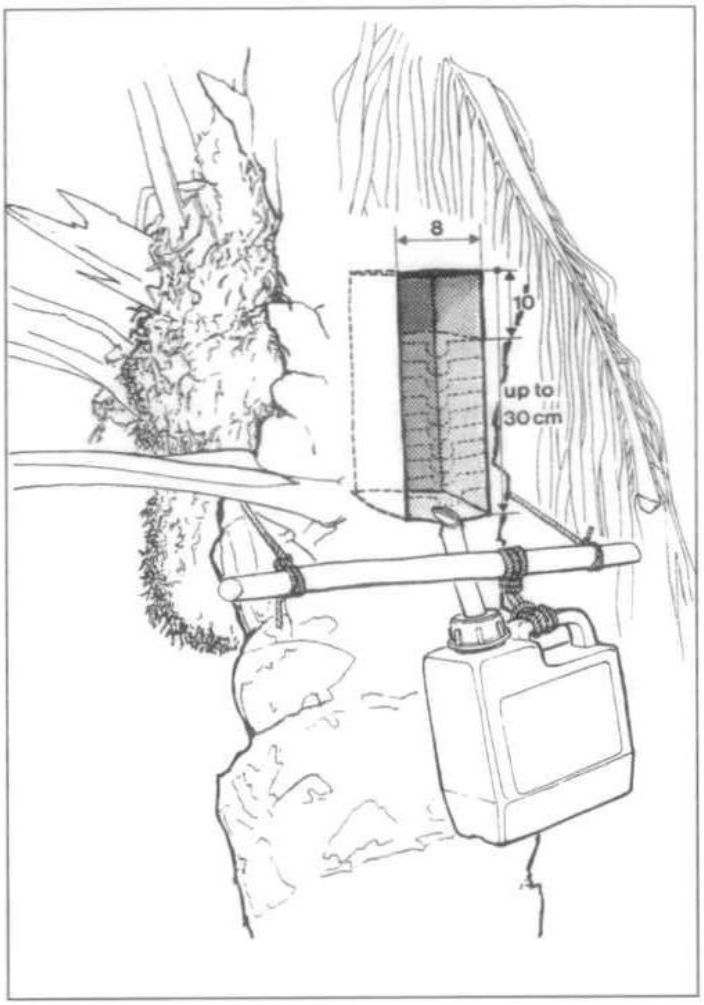

Fig. 4b: Stage of the tree towards the end of the sapping period. (Drawings by Tambour from a picture taken by the author in Nigeria).

3.3 From felled trees:

This is the method by which, mainly in West Africa and particularly in Ghana, the oil palm is sapped. Using a spade the roots are loosened and the tree pulled down. The tap roots are cut ending contact with the soil . In addition, several leaves are cut two weeks after the felling of the tree. At the growing point a bowl-shaped hollow (10 cm x 9 cm) is cut in the stem, about two-thirds the diameter of the stem in depth (15 cm), in which the sap collects and the tree is left for two more days. Using a suctionpipe (approx. 15 cm long) the collecting sap is then emptied into a container under the stem (Fig. 5). As in all the methods of tapping palm sap, the tapper must twice a day, morning and evening, cut away a millimetre-thick layer of the tissue, for otherwise the flow of sap comes to an end. This can extend the length of the bowl-shaped hollow basewards to 30 cm before the sap flow stops. In addition, the stem surface around the tapping wound must be flared with fire during every cut. For this the tapper uses dried palm branches (leaves) tied together. The effect of this treatment is not clear. It is, however, definitely necessary to get a good harvest of sap. In any case, this pretreatment kills off

the larvae of the beetle *Oryctes spp.*, which can quickly destroy felled and mutilated oil palms. Sap can be obtained from felled oil palms without further manipulations. By contrast, the tapping of other palms (*Cocos, Arenga*) requires a pretreatment, which usually consists in striking the stem with wooden sticks at regular intervals before the wound is opened.

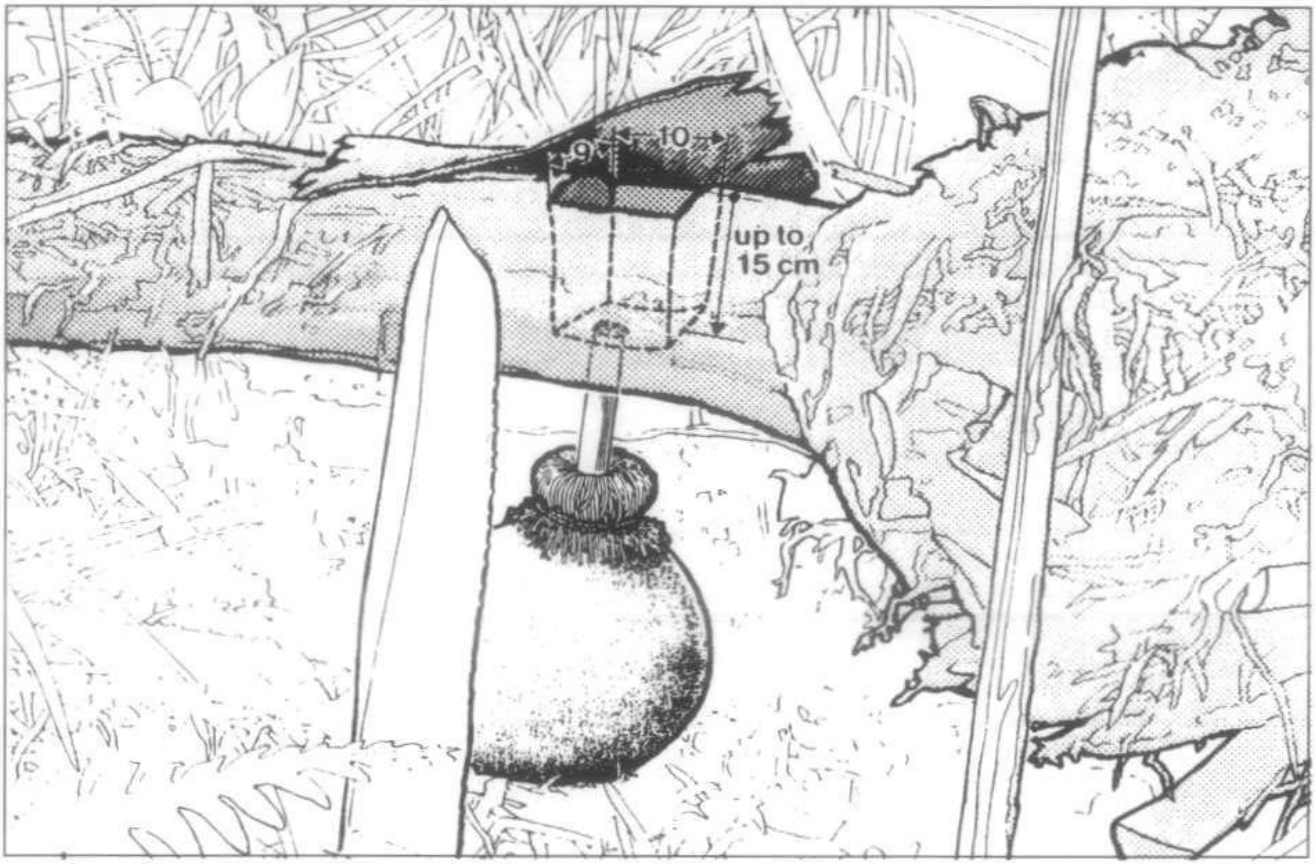

Fig. 5: A felled oil palm delivering sap. (Drawing by Tambour from a picture taken by the author in Ghana).

4 A new method of obtaining oil palm sap

The main aim of this method is to develop a sapping instrument which can be used to sap intact oil palm and at the same time prevent the tree from dying by controlling the sap outflow.

The instrument was to have the following characteristics: easy handling, no energy supply or pump needed, robust and not susceptible to repairs.

The handy instrument (Fig. 6a) is made from „Teflon" and contains two outlets. The top outlet embodies a cavity containing glas-wool and active charcoal soaked in paragallol. The paragallol absorbs oxygen entering the tree through the cavity so as to prevent occlusions (Callus and P-Proteins) at the wound surface to ensure continous sap flow. The bottom outlet is connected to one end of a long tube whose length

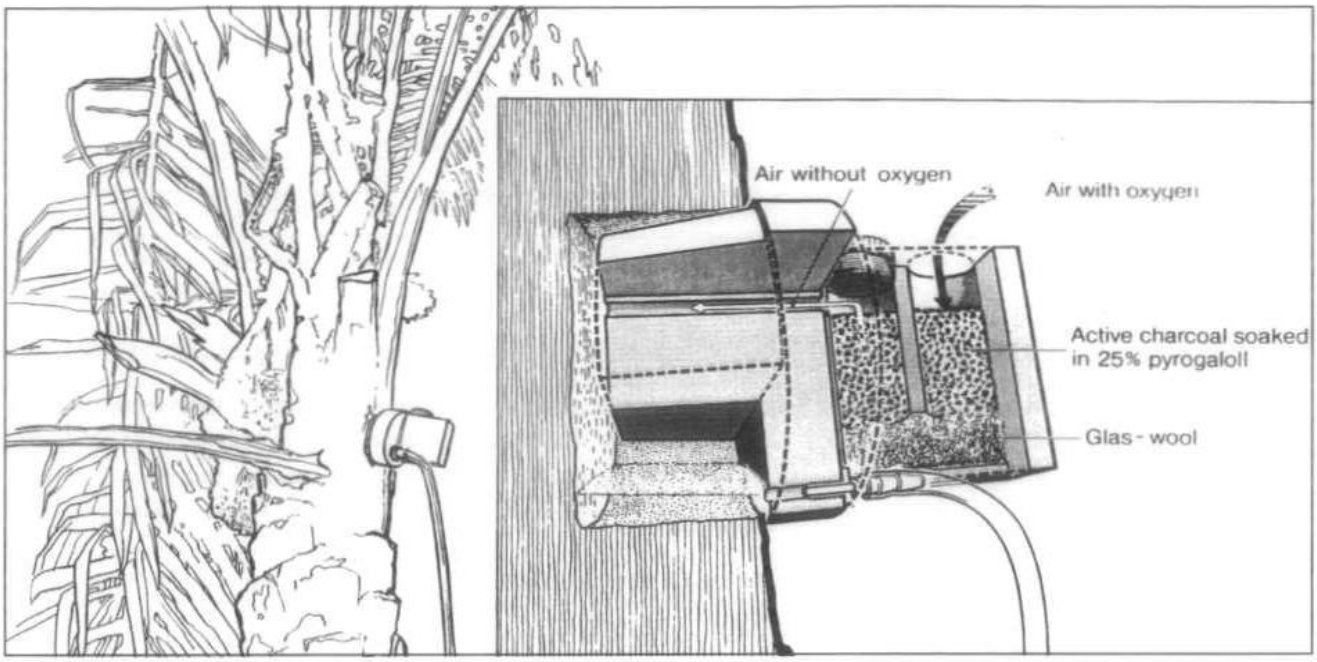

Fig. 6a: A sapping instrument fixed into the stem of an oil palm.

Fig. 6b: A sapping instrument connected to a container through a tree-high tube. (both drawings by Tambour from pictures taken by the author in Ghana).

depends on the height of the tree to be sapped. The other end of the tube with a clamp is then connected to a container at the base of the tree, into which the collecting sap is emptied. This saves the tapper from climbing the tree often to collect the sap. At the growing point of the stem, a hollow is cut in which the instrument fits exactly. It is then made watertight with tree-wax. The connecting tube is then filled with water before one end is connected to the instrument so that the sap can be pulled down by gravitational force when the tap is open (Fig. 6b).

5 Distillation of palm wine

As mentioned in the introduction, the inhabitants of West Africa tapped palm sap long before the region was colonized. In addition, they used low-cost equipment to distill the sap into high quality alcohols (Gin, Schnapps) comparable to European alcoholic drinks. In Ghana schnaps from palm wine was called „Apeteshie" while it was known as „Ogogoro" in Nigeria. Due to the high percentage of alcohol (over 80%), the British tried to ban it without success since the production was limited to small village scale deep in the forest. The distillation equipment consisted of oil drums (Fig. 7).

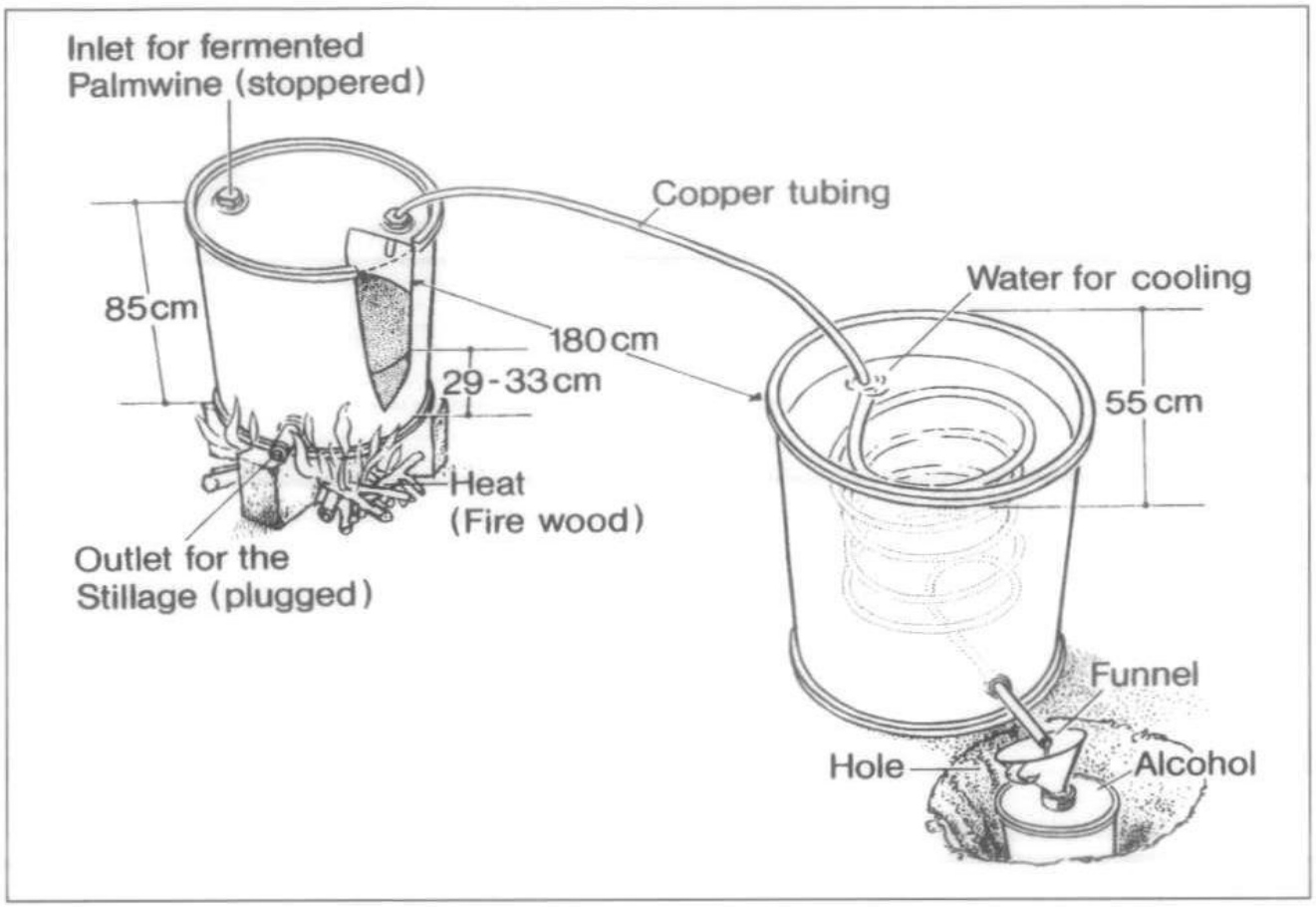

Fig. 7: Distillation equipment. (Drawing by Tambour from a picture taken by the author in Ghana).

Now due to the scarcity of palm wine, only a small percentage of the schnapps is distilled from palm sap and over 80% distilled from raw materials such as sugar, molasses, cocoa bean pulp juice and others. Most of the indigenious alcoholic drinks are therefore dangerous to health due to a higher percentage of methyl alcohol and other chemicals added.

6 Some experiences with different methods of palm sapping

6.1 Duration and quantity of sap flow

6.1.1 From the inflorescence:

Palm wine production depends on the number of male inflorescence available and on the quantity produced per inflorescence. According to HARTLEY (1977), yields in Nigeria were highest at the beginning and end of rains in the periods March-April and October-November. Mean monthly production was 149 litres.

6.1.2 From felled oil palms:

A felled palm stem yields on the average 4 L of sap daily, and for a sapping period of two months. The amount of sap and the length of flow depends on the age and size of

the tree, and also upon the experience of the sap-collector. The longest sapping period lasts about four months, assuming the tree was sound and the collector knew how to prevent attack by beetles. It happens sometimes that the flow of sap stops after two weeks. The flow begins slowly and rises to a maximum; towards the end of the sapping period the amount of sap exuded declines slowly and finally ceases.

6.1.3 From tested oil palms:

The main idea was to find out if the system could function like a water pipe so as to control the sap flow. This problem could not be finally solved since there were construction mistakes on the instrument to be corrected. Apart from that the paragallol gave a strong scent to the sap which made it undrinkable. No measurements were therefore undertaken. However, it was interesting to note that the tree quickly recovered and closed the cut gap when the cut was made at the base of the third roll of leaves from the apex. This was unusual since cut gaps remain unclosed due to lack of vascular cambium in palms.

6.1.4 From other palms:

For comparison, data for other palms are available. A sabal palm (*Corphyra elata*) produces from its stem tip the astonishing amount of 45.2 L a day. GIBBS (1911) measured 2699 L of sap in a sapping period of 132 days. A date palm produced 19 l a day from a notch in the stem (BOSE, 1927). According to STOCKING (1956) a palmyra palm was said to have given 120.000 L of sap during its lifetime. In the case of an *Arenga* palm which yielded 5-6 L a day of exudate from the inflorescence, a speed of 7 m/h has been calculated.

6.2 Source and composition of palm sap

HANS MOLISCH (1898) was one of the early researchers to investigate about the origins of the sap bleeding. He concluded from the coincidence of the blocked xylem vessels and the need to renew the cut surface repeatedly to achieve a continous flow of sap, that the xylem delivered the sap. Only in the last twenty years did the Dutch scientists P.M.L. TAMMES and IAN VAN DIE, using a model plant, *Yucca flaccida*, succeeded unequivocally in tracing back the phenomenon of palm bleeding to the phloem. The procedure mentioned above of beating the palm stem or branch at a place where sap is to be taken, leads MILBURN'S opinion to a stopping up of the xylem paths, as MOLISCH had already observed. This occlusion of the vessels prevents the exudate coming out of the sieve tubes being sucked back immediately into the vessel, for the plant has a high water deficit, especially if it has been felled.. To prevent these important occlusions of the vessels from being removed, it is important for the collector daily to cut away wafer-thin layers from the phloem tissues. By this process, apparently, only sieve plates are removed whose pores had been clogged up with callus and P-protein.

The anatomical structure of the ripe sieve tubes suits the process of exudation. The sieve tubes have no vacuoles and their cytoplasm has organelles only along the cell walls, like mitochondria and endoplasmic reticulum. They have no cell nucleus. In particular, in palms, as in most monocotyledons, callus is formed to a lesser degree than in dicotyledons. PARTHASARATHY (1980) obtained very convincing ultrastructural evidence that the sieve tubes of palms can remain functional for many years.

The material composition of palm and *Yucca* exudates corresponds to the phloem exudates of other palms. Tab. 1 shows the composition of some typical constituents of sieve tube exudates of *Arenga* (palm), in comparison with *Lupinus albus* (a dicotyledon).

Tab. 1: Typical constituents of sieve tube exudates of *Arenga* (TAMMES, 1958) and *Lupinus albus* (PATE et al., 1974).

Material	*Arenga* (palm)	*Lupinus* (dicots)
Saccharose (mg/ml)	149-170	154
Amino acids (µM/ml)	81	88.6
K (µg/ml)	1200	1540
Mg (µg/ml)	96	83
Ca (µg/ml)	10	21
pH value of exudate	8.0-8.2	7.5-8.0

The oil palm wine (sap) has a milky appearance due to high concentration of yeast. It has a slightly sulphurous smell because of its sulphur-protein content. BASSIR (1962) found many yeast cells and 2 main types of bacteria in the sap after 8 hours fermentation in the open air at about 25°C. As the wine is not collected under sterile conditions fermentation is quite rapid, but if this has not proceeded too far the wine forms a nutritious drink which provides an important source of vitamin B complex.

The pH of the fresh wine is 7.4; it falls to 4.0 when the fermentation ends. The wine is usually drinkable at pH 5.5-6.5 after 12 hours of fermentation. In Nigeria organic acids identified in palm wine include acetic, lactic and tartaric acids as well as thirteen amino acids.

The most astonishing fact, however, is the immense amount of sap that can be obtained from many palms, whereby for a long time there may be scarcely any diminution of the sugar concentration. In the exudation process very rich reserves of carbohydrates must be converted into sugar. One supposes these are starch stocks from the palm stem. Accurate experiments, but using the convenient *Yucca* plant and employing C^{14} compounds, have shown that even the leaves can contribute up to 21% of the exudate sugar (VAN DIE, 1975). The same may also apply for palms in as much as their leaves are able to photosynthesize.

The problem of water supply has not yet been examined experimentally. Not only does photosynthesis require water, but also the hydrolysis of the reserve starch uses water. It is therefore reasonable that the constant loss of water caused by the outflow of the syrup must sooner or later prevent the photosynthetic and hydrolytic process of sugar formation. In the case of trees whose roots remain in the ground during exudation, this will be compensated for by the uptake of water. Where trees have been felled, as with the oil palm, the sugar-rich phloem sap draws to itself by osmosis all the available water. The parenchymatous tissues will lose their turgor and shrink until finally the stem will be held in shape only by sclerenchymatous tissues. Photosynthesis will cease because of lack of water, and hydrolases will no longer be able to break down starch into sugar since like all enzymes they can only operate in a watery milieu.

7 Disadvantages of inefficient sapping methods

The method of felling a tree after ten or more years'growth in order to sap a few litres of its sugary exudate is not only inefficient, but seriously threatens the economic capital represented by the oil palms. Through this method, thousands of palms are destroyed per year in West Africa, especially in Ghana. In spite of oil palm plantations being set up in many West African countries, the situation remains unchanged since products from these plantations are either exported or meant for industrial use. The majority of the inhabitants however, depend on palm trees growing naturally in the rain forest, which is gradually being destroyed. This unfortunate situation has already gone so far that palm oil, palm kernel oil, and also palm wine products, which in the past were abundant, have become scarce. Apart from the fact that cooking oil is expensive, palm wine makers have already turned to sophisticating the scarce palm wine by adding water and sugar. This leads one to ask whether the oil palm could be sapped by puncturing the upper stem as with *Raphia*. Unfortunately these palms also die after being sapped. As long as no advantageous new method of obtaining sap is found, West African farmers will go on felling oil palms, for it is simpler to get the sap from felled tree than to climb the tree for it thrice a day.

8 Conclusion

Oil palms play an important role in the life of West Africans. Its importance complies with the saying in West Africa "man throws no part of the oil palm away". Paradoxically, the opposite happens by the sapping whereby the tree is destroyed after 6 or several years growth.

In this paper the radical methods of sapping the oil palm have been described and discussed. The traditional methods of obtaining palm sap from felled trees and from the upper stem cannot be justified since the trees dies afterwards. In order to combat the danger of a further decimation of this important economic tree in the tropical rain forest, a new method of collecting sap, leaving the tree intact was tried. There is more

experimental work needed to improve this method of puncturing the upper stem before it can be put to use. In addition, the use of the new method to sap young male inflorescences of the oil palm, which is a justifiable procedure for obtaining palm wine, is under consideration. Financial support is however needed if this research is to succeed. This is particularly timely since the palm wine industry is of considerable economic and nutritional importance in West Africa, but has received very little scientific attention.

Zusammenfassung

Die Ölpalme spielt eine bedeutende und verschiedenartige Rolle im Leben der Westafrikaner. Leider wird der Baum nach 10 oder mehrjährigem Wachstum gefällt, nur um ein einziges Mal Saft zu gewinnen. Diese traditionelle Methode der Saftgewinnung zerstört viele Ölpalmen pro Jahr, und ist eine große Gefahr für das ökonomische Kapital, das die Ölpalmen darstellen. Um der Gefahr einer weiteren Dezimierung dieses wirtschaftlich so wichtigen Baumes zu begegnen, müssen Anstrengungen gemacht werden, neue Methoden der Saftgewinnung zu erforschen, bei denen der Baum erhalten bleibt. Eine derartige Methode der Saftgewinnung wird am Forstbotanischen Institut der Universität Göttingen entwickelt. Ein Erfolg dieser Forschung würde u.a. die Gesundheit und den Lebensstandard derjenigen Westafrikaner sichern, die von der Ölpalme abhängig sind.

Acknowledgement

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This article is dedicated to Professor Walter Eschrich on the occation of his 68th birthday.

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