PHARMACOGNOSTI CAL STUDIES OF SOME LOCAL PLANTS OF COSMETIC VALUE WITH SPECIAL REFERENCE TO EUCALYPTUS SPECIES

BY

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A THESIS SUBMITTED TO THE POST-GRADUATE SCHOOL, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE PHARMACOGNOSY

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D E C L A R A T I O N

I hereby certify that the work reported in this thesis was carried out by me under the supervision of Dr. A. Ghani and Dr. M. Shok of the Department of Pharmacognosy and Drug Development, Faculty of Pharmaceutical Sciences, Ahmadu Bello University, Zaria, Nigeria. The works of other investigators are acknowledged and referred to accordingly.

I declare that no part of this thesis has been submitted elsewhere for a degree.

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CERTIFICATION

This thesis entitled "PHARMACOGNOSTICAL STUDIES OF SOME LOCAL PLANTS OF COSMETIC VALUE WITH SPECIAL REFERENCE TO EUCALYPTUS SPECIES" by ZAINAB ABDULLAHI meets the regulations governing the award of the degree of MASTER OF SCIENCE (Pharmacognosy) of AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA and is approved for its contribution to knowledge and literary presentation.

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D E D I C A T I O N

This project is dedicated to all those that I love

and

To the young men and women the world over who have used obstacles as stepping stones to achieve greatness.

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ABSTRACT

Various local plants contain volatile oil that have been used as cosmetics or in the preparation of cosmetics throughout the ages. The uses and constituents of those growing in Nigeria have been reviewed and discussed. In this connection, the history of cosmetics and possible factors that may be responsible for its spread have also been outlined,,

In an attempt to establish some differentiating character*jts* of the three Nigerian Eucalyptus species^ namely^ Eucalyptus citriodora, E. tereticornis and E. camaldulensis, certain criteria such as quantitative microscopy and physical constant values of the plants were determined. Values of the stomatal number, palisade ratio, vein-Islet number and the stomatal index so obtained may be of use in differentiating between the three Eucalyptus species. Also, the sizes of the epidermal cells, stomata and oil-glands may also be useful in this respect. The results obtained in each case have been discussed. Physical characters such as the odour of the species may serve as a distinguishing factor. Thus, while E. citriodora is 'citron-scented, the other two species have camphoraceous odours.

Extraction of oils of the Eucalyptus species was carried out in different seasons;i.e.dry and rainy seasons using both dry and fresh leaves to determine the effects of seasonal variations of the quality and quantity of the

volatile oils. Results obtained showed a higher oil yield in E. citriodora in both dry and rainy seasons when either,the fresh or dry leaves were used. In general, the dried leaves of all the Eucalyptus species, except E. citriodora, yielded more oil in both seasons. Some other plants, namely, lemongrass, Ocimum, clove, tangerine, ginger and peels of orange^were also extracted to determine their total volatile oil contents.

The chemical constituents of the oils of the three Eucalyptus species were ascertained by Thin-layer (TLC) and Gas Liquid Chromatographic (GLC) separations. E. citriodora was found to contain citronellal as the principal constituent. Other constituents identified were cineole, citronellol and geraniol. E. camaldulensis was also seen to contain similar constituents, while E. tereticornis containted all the above constituents except geraniol. These results have been discussed and compared with those of others on the same plants grown elsewhere.

Benzene : ethylacetate (95:5) and silica gel GF was found to be the best solvent system and adsorbent layer respectively for the TLC separation of the oils. Analysis of the constituents of the Eucalyptus oils was also done using GLC. Citronellal was found to be the main constituent of E. citriodora and cineole to be the main constituent of the other two species. The GLC results compared favourably with those obtained by TLC.

The anti-bacterial and antifungal properties of these oils were studied using microbiological techniques. They have been found to be effective against Escherichia coli, Staphylococcus aureus and Candida albicans. It was observed that all the oils had some degree of anti-fungal and antibacterial activity. Thus, an explanation as to why the oils of clove, lemon grass, Ocimum, etc, are used in local cosmetic preparations was obtained.

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ABBREVIATIONS

mm	=	millimetre
g	=	grams
U.V	=	Ultra violet
^{o}C	=	Degrees centigrade
ml	=	millilitre
µ	=	micron
i.e.	=	that is
cf	=	compare with
sq.	=	square
%	=	percent
v/w	=	volume per weight
bl	=	blue
g-b	=	greenish brown
pu	=	purple
br	=	brown
yell.	=	yellow
fig.	=	figure

CHAPTER 1

1. INTRODUCTION

1. INTRODUCTION

1.1 INTRODUCTION

The desire for looking attractive is inherent in human beings, particularly in the females. Cosmetics play the key role in helping them in this effort.

Cosmetics is a general term applied to:-

(1) Articles intended to be rubbed, poured, sprinkled or sprayed on, or introduced into or otherwise applied to the human body or any part thereof for cleansing, beautifying and promoting attractiveness, or altering the appearances, and

(2) Articles intended for use as a component of any such articles, except that such term shall not include soap (Nostrand, 1976).

However, cosmetics was not always used to beautify or promote attractiveness. They were used for various other purposes as well. Throughout recorded history, man has painted his face at times decorating it boldly with elaborate colour designs to achieve some specific purposes.

The use of cosmetics dates back to the remotest antiquity. But why man or woman first applied paint to the face or when it happened is lost in the mists of prehistoric times.

Early tattoos appeared to have been associated with puberty rites or to have had magical and religious significance and date back to ancient Egypt. It was also, among certain tribes, a mark of status. Native chieftains sometimes had different facial markings from those used by other members of the tribe, or success in hunting may entitle one to use special markings.

Although it is generally believed that cosmetics as they are now originated in the Arabian world, the study of primitive culture indicates that various forms of cosmetics for beautification have been practiced in every part of the world as well. The warpaint of the American Indians, tattoos and scarification practiced by many primitive tribes are examples. The woad, Isatis tinctoria, the source of a blue dye prepared from the leaves, was used by ancient Britons to paint their bodies (Akinjogbin, 1985). All these are forms of ancient cosmetic adornment.

Historical Uses of Cosmetics

The history of cosmetics is as old as Man's civilisation. Its uses are as primitive as the earliest religion, for before man had invented gods, he was aware of a force of evil against which he must assume disguise.

Because early man lived in terror and menaces were unseen and so more horrifying, painting the face

they believed could resist attacks by making them to appear threatening. Priests and priestesses, celebrants and dancers were often painted as a necessary ritual. Warriors were painted to disguise them and to awe the enemy. Their bodies were usually smeared with yellow, white, red and grey colours laid on like crosses or such other religious shapes which were very hideous to behold. Usually, products of their own imaginations were painted on their faces distorting them into 'devil-masks'. Women who sat at home pounding corn were often in their natural states as they did not have enemies to frighten. As more social interactions took place, enemies were more usually other men. So women resorted to painting their faces as a form of disguise too.

Later, the use of paint was incorporated into some social activities like wedding, initiation and burial ceremonies. Although primitive man did at times use make-up to frighten enemies, it has always been used to attract lovers and friends and to bolster self confidence. So, probably very early face painting also came to be thought of as a method of beautification. This might have been brought about through experimentations of body paintings which probably made the wearers to be more attractive and even beautiful.

Man therefore started improving on the art of make-up as a means of beautification, if only to attract the opposite sex.

Origin of Cosmetics

Historical studies revealed the earliest phases of cosmetics to be associated with religions practice. This phase is known to have started with the early Egyptians.

Aromatic incence, oils and unguents (perfumed ointments) for anointing both the living and the dead persisted in many religious rites. In public temples and shrines in homes mixtures of fragrant gums, resins and scented woods were burnt as incence by the Egyptians, Assyrians, Babylonians and others. Available materials within one country was utilized and were exchanged for exotic substances carried by other traders. Men and women of Egypt used ointments and perfumed oils to keep the skin supple and to prevent wrinkles in the sun heat. Paints and dyes served as colourants for the pomades and oils. Make-up was also used by both sexes as part of the daily routine, and they went to their final resting place supplied with cosmetics for the next world. A tomb, that of Tutankhamum, a renowned Egyptian, has been found in Egypt which still contains a 3000-year old skin cream composed of approximately nine parts of animal fat to one part of perfumed resin (Corson, 1972) (fig.1). Fragrant oils and perfumes found use in mummification (embalming the dead) and as offerings to the gods. Ramses II, the most celebrated of all Egyptian kings, lived from 1324 to 1258 B.C. and was shown offering incence in the



FIG. 1: Ancient Egyptian cosmetics jar. Made of calcite, hardstone, and ivory. Found in the tomb of Tutankhamun, it contained 3,000-year-old skin cream still in good condition.

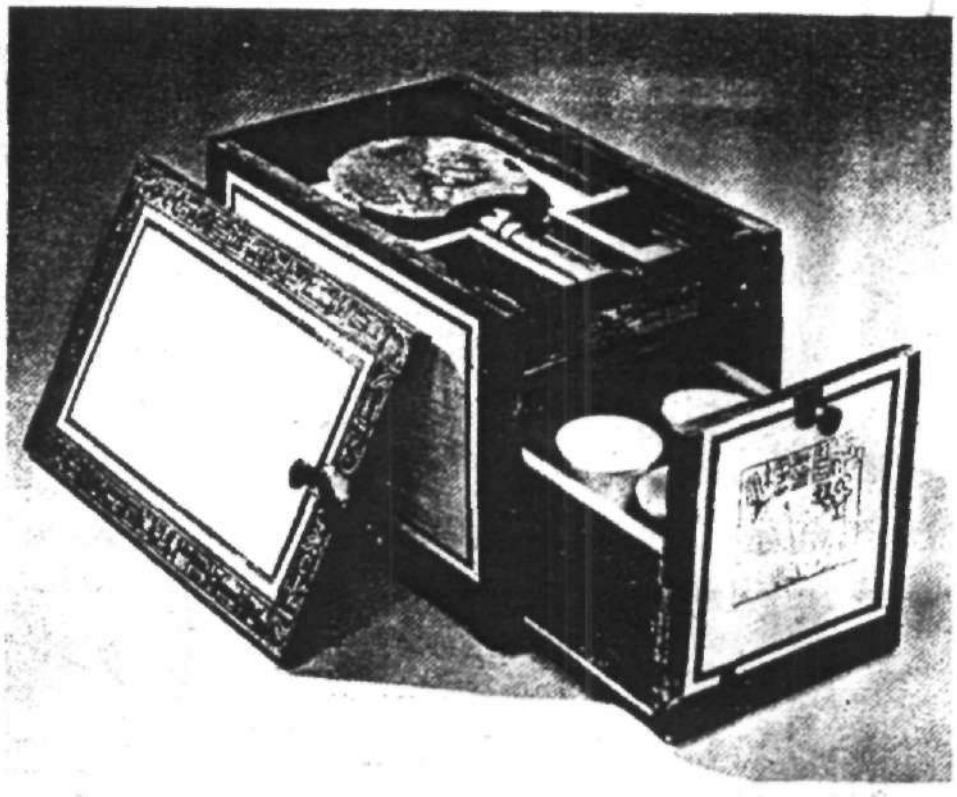


FIG. 2 Egyptian cosmetics chest of cedar, *c.* 1795 B.C. The drawer contains alabaster cosmetics jars

temple of Abu-Simbel to the god, ptah. This showed how important the use of perfumes and incence were in religious rites.

The origin of Egyptian cosmetics can be traced to the mesolithic period (1000 - 5000 B.C.) when the land was composed of hunters and shepherds living in the valley of the Nile. They often smeared their bodies with grease and oil from Ricinus communis, the castor plant (Angeloglou, 1970) and had tattoos marks on their faces and bodies. Later as the early Egyptians settled to an agricultural way of life (about 3500 B.C.), they developed cosmetics as protection against the sun. Evidences of such cosmetics have been found by archeologists in the remains of their villages and tombs (Angeloglou, 1970). The tomb of Tutankhamum is also known to contain some vases of perfumed ointment that were subjected to analysis in 1926 (Wells and Billot, 1981).

In later years, cosmetic products were made in the home and the arts of application were also practiced there. Through commerce, the cosmetic products of Egypt were carried principally in ships to all countries around the Mediterranean. As the Egyptians were famous as teachers, their knowledge and practices passed successively to the Assyrians, Babylonians, Hebrews, Persians and the Greeks.

Forms of Ancient Cosmetics

Apart from rubbing fragrant oils on the skin, the Egyptians used the leaves of Lawsonia inermis (Henna) and litmus for staining the skin, nails, palms and soles of feet and hands (Angeloglou, 1970).

White stains and yellow ochre were used for whitening the skin, indigo for dyeing the hair and also henna for same. Whatever else the Egyptians did or did not do, they seldom failed to line their eyes heavily with Khol. This is the equivalent of the local 'Kholi' or 'tiro'. All these forms of make-up were common knowledge to countries around the Mediterranean too, but there was however some variety in perfumes as each country utilized its own native products.

The use of cosmetics was not restricted to age or sex. Of notable importance was the use of eye paints. By 5000 B.C. its use had become quite sophisticated even though only two colours were available (Angeloglou, 1970). These were the antimony powder used to etch the eye brow shape and the green make-up used around the eyes to design and beautify them. In this respect, the eye make-up of the Egyptians was not strikingly different from those of the fashionable 1960s women, who usually placed exaggerated emphasis on the eyes, often to the point of complete stylization.

Hair styles and dressing were very much indulged in and hair-growth was symbolic. It signified strength among men and women used their hair as an aid to general charm. False hair (wigs) was borne with natural hair and in the privacy of homes, flowers were braided into the hair and secreted perfumed balls put near the scalp which when melted slowly seeped through the plaits.

The use of perfume had at first been restricted to the priests. Its use was originally associated with death, for the art of perfumery, like so many other cosmetics can be traced to the Egyptians, and for them scents and the use of perfumed oils were mostly associated with the mystery of death. Perfumes were also used as incence or perfumed unguents offered to the gods in religious ceremonies and also for personal enjoyments and adornment as today but then only by the priviledged few.

Many of the creams, ointments and perfumes which are used today and which are advertised as renewing youth or adding vitality, originated in the ceremony of mummification. The Egyptians had particular affection for flowers and these they added to their ointments in an attempt to preserve and make them fragrant. Myrrh, musk, sandal wood and many scented flowers which are still used in perfumery today were commonly used. As perfume-making was dominated by religious priests, it quickly became a "blackmarket"

commodity and later as a trading weapon with adjacent nations. Ointments and perfumes travelled about the Mediterranean following the fashions of time.

Modern knowledge about perfumery came from Pliny who lived in the time of Christ. He recorded these potions which captivated the ancient world. The notable centre for perfumery in Egypt was Mendes and to it came raw essences from other countries. Saffron was brought from Rhodes, Chypre from Cyprus, and a host of others.

There was a regular barter trade in sandal wood in ancient times, when caravans carried the precious fragrant woods from India to Egypt, Greece and Rome. India came to be known as a source of fine perfumes and centres like Kanauj, Jaunpur, Ghazipur and Lucknow acquired high reputations in this respect. All forms of cosmetics were practised by the Egyptians: sand and rind were used as body and face-scrubs to clean the pores - the basis for today's Mud-baths. Wrinkles were evaded by using face-masks of egg-white and ochre was used as rouge; a form of cosmetic used to paint the cheeks. Eye shadows of all colours were experimented with and the pigments for them derived from the natural ores available in the nation. Pumice-stone was used, as today, to remove body hair as well as to smoothen the rough skin on knees and elbow.

Such cosmetics were kept in special containers in toilet-bags. Some of them can still be seen in tombs and museums around the world. That belonging to Thuthu, the wife of Ani,is still kept in the British Museum (Angeloglou, 1970). Ivory and wood for holding eye pencils, dishes for mixing ointments, special boxes which hold face creams and ointments and exquisite bottles for perfumes were found in her toilet bag (see fig. 2). Cleopatra, one of the notable Egyptian Queens of the late pre-Christ period,was a symbol of cosmetics and beautification. She was reputed to be thoroughly skilled in the art of compounding and applying cosmetics of all kinds. In her cosmetic box was found a container which contained an ointment to shield her eyes from the glare of the sun and also a bronze dish in which she mixed her own colours adjusting them to suit her taste and the occasion. She was an important factor in the spread of the knowledge about the art and science of compounding and applying cosmetics, for when the Romans captured Egypt and Cleopatra was taken captive, she became to them an idea rather than reality and her subtlety was enhanced by the use of make-up which seemed outrageous to them at first. Nevertheless, the ladies of the Roman court soon quickly adopted her fashion and use of cosmetics which also extended to the men.

Spread of Egyptian Cosmetics

The Egyptians were reputed to be good traders and teachers. As trade and religion spread, so did the knowledge of cosmetics, its formulation, compounding and the application. New converts were rewarded with gift items such as cosmetics and the containers, and such items were also exchanged for other goods which sometimes included slaves.

The trans-Atlantic trade was responsible for the initial contacts of the Africans with the Arabs. These contacts led to the assimilation of some practices and habits of the Arabs such as the use of some of their cosmetics items and the art of compounding them.

In warfares, captives were forced to impart their knowledge and skills. All over the world, trade, religion and warfares may be said to be some of the factors responsible for the spread of Egyptian cosmetics. This is not to say, however, that other nations obtained the first knowledge about cosmetics solely from the Egyptians. Other nations were already using their own resources to achieve the same looks of the Egyptians. However, the practice of the art and science of cosmetics may not have been as refined as was in Egypt.

The universal use of cosmetics in modern times has followed the scientific study of the ingredients employed in ancient years.

1.2 EARLY COSMETICS IN NIGERIA

The history of cosmetics in Nigeria, since it has not been documented, is difficult to trace. However, the art of painting the face and body has been known to exist since the earliest times. Make-up was used by warriors going to wars as a camouflage. It was also used as a form of disguise from the 'evil-eye' and other unseen menaces.

Priests, 'babalawos', priestesses and other religious leaders painted their faces and bodies as a necessity in religious worships. The art of painting the body was incorporated in all daily social activities and festivities such as hunting, wedding, burial ceremonies and folk dances. Chieftains were identified with special paintings.

Later on, some paints and pieces of strange woods obtained from the surrounding vegetation were seen to produce an attractive effect. This led to the use of such items for beautification and to promote attractiveness. They knew what to use to cure certain skin disorders and were aware of the value of hair care.

For perfumes, they obtained fragrant woods and leaves from the bush, rubbed them in between their palms and simply rubbed on their bodies and clothings (Aishatu, 1985). Fragrant sticks and woods were also burnt as incence. The ancient Nigerian, like his Egyptian counter-part, was familiar with the process of embalming the dead using scented oils and woods (Usman, 1985).

To keep the skin and hair supple and attractive, oils of seeds of some plants were used. They obtained sticks to chew in place of the modern tooth-brush and certain flowers were chewed to stain the lips a red colour, which was attractive to behold.

Until the establishment of the British protectorate, cosmetics used by Nigerians were almost entirely provided from the surrounding flora. With none of the modern cosmetics factory at her disposal, the Nigerian woman was able to effect a most fetching make-up from the strange pieces of wood, black stains, fragrant balls and sticky mixtures, some of which are still sold in markets (Aishatu, 1985). Local plants which yielded oil and fat provided the basis for body perfumes. Plant juices that can imitate tattooing or produce a lather were used for washing; sticks to apply galena around the eyes and even vegetable sponges and of course the containers for the cosmetics were obtained from plants.

Not only women worried about their appearances, men also used cosmetics even though on special occasions like ceremonial dances, wedding, burial ceremonies, etc.

Some Plants Used in Local Cosmetics

In local cosmetics, the most commonly used plants were those which provided the fatty bases for the pomades, dyes and perfumes. Vegetable fats like castor oil from Ricinus communis, palm-kernel oil from

Elais guineensis, groundnut oil from Arachis hypogaea, Kundan oil from Carapa procera, oil of Ben from Moringa oleifera, Kanya butter from Pentadesma butyracea and oil from the nut of mahogany tree, Afrolicania alaeosperma, which is also said to stimulate hair growth (Dalziel, 1937), were used. These pomades were often mixed with black dyes like the decoction of Ipomea repens, the common convolvulus or with red dyes like Lawsonia alba (Henna). Starch of squill (Urginea altissima) was used to stiffen the hair and for tinting and adding gloss to the hair Indigo and Yoruba Indigo from leaves of Lonchocarpus cyanescens were used. Oil of seeds of Colocynthis vulgaris (Colocynth) was useful in blackening grey hair. Products available to each locality were used to achieve the same make-up effects as in other parts. Among the Yorubas, a black vegetable called 'buje' from Randia cordata was used to stain the lower lid, and antimony, 'tiro', to accent and beautify the eyes. Baphia nitida (camwood) was used to conceal ugly spots and to generally beautify the body. For dental hygiene, the local flora offered a great variety of tooth sticks used for cleansing the teeth. Twigs of Anisophylla laurina (monkey apple), leaves and roots of Amaranthus caudatus, fruits of Salvadora perisca (love-lies-bleeding) and the sepals of Mussaenda afzelii were used as tooth brushes. A popular mouthwash was made among the Yorubas from the bark of Bridelia ferruginea

and was called 'epo-ira' (Aishatu, 1985). This was sold in the markets in the form of soft pieces or already prepared in bottles as a bright red mixture of an infusion or decoction of the bark and lime juice (Iya Olomi, 1985).

In Northern Nigeria, women used galena, 'kholi', to accent the eyes and this was often mixed with different plant ingredients to produce 'love-charms' (Aishatu, 1985). This was supposed to render the user irresistible to the other sex. Young men often prepared a mixture to rub on the eye lids by adding the crushed fruits of the "Giraffe tree", Mearua angoleusis, and women added a paste of pulverised seeds of 'crab's eye' vine, Abrus precatorius.

The nail of hands and feet were often tinted a dark-orange with 'lalle' (henna) which was prepared by mixing the dried olive-green powder of the leaves of Lawsonia alba with water and a little lime-juice. Sometimes leaves of a common weed, Chrysanthellum procumbens were mixed in. On applying the henna, feet or hands were tied with leaves of Ipomea repens or 'fire-bean', Adenodolichos paniculata, or alternatively, the hands were immersed in the club-shaped or cylinderical gourds of pumpkin or calabash, Lagenaria vulgaris. Sometimes, hair, teeth or skin were also dyed using henna. The Edos of Benin stained finger nails and eye lid with decoction made from the skin of chameleon and certain leaves (Etomi, 1985).

Where less clothes were worn, more attention was paid to the body which was often anointed to make the skin smooth and shiny. Sometimes the colour was intensified by using black or red stains. Readymade body pomades in the form of brown balls or fragrant masses (called 'atiki' in Northern Nigeria), which consisted of seeds of Tetrapleura tetraptera mixed with palm oil or scented oil, was sold in the market. Balls of red paste, 'majigi', made from a triturated dye-wood, Pterocarpus erinaceus, mixed with palm oil was used to smear body and certain hair coifures, a type of hair-dressing. Other vegetable fats used as body pomade were oils of Ongokea klaineana and Balanites aegyptiaca.

A common practice among the Nigerian women was the use of certain plant parts to achieve the effect of the modern lip-stick. The root bark of Bauhinia thonningii and Stereospermum kunthianum were chewed to redden the lips.

Common among the Fulani and Kanuri tribes was the chewing of kolanut to stain the teeth red. Flowers of red-flowered silk cotton, Ceiba pentandra, and those of the yellow flowered tobacco plant, Nicotiana rustica or of Solanum macrocarpon were also used sometimes while a piece of kola was being chewed. Sometimes leaves of an indigo variety, Lonchocarpus philenoptera, was chewed to darken the teeth. For scenting pomades, fragrant essential oils incorporated in them included

oils from flowers of henna, rind of the fresh fruit of Parinari macrophylla, the ginger-bread plum tree and crushed seeds of Piper guineense. Crushed seeds of Guinea pepper, Xylopia aethiopica, Aframomum granum-paradisi and oleoresin of the gum copal tree, Guibourtia copallifera, were also used. Included also were Daniella ogea and African elemi, Canarium schweinfurthii. Others were grounded roots of Cyperus articulatus, C. maculatus, Kyllinggia erecta, Vertiveria nigritana and Elionurus elegans.

For the Igbo and other Easthern Nigeria tribes, no social or religious ceremonies were complete without the art of body-painting when dyes were used to make different designs on the face and body.

Uli-painting, the loveliest of the body-painting arts, was done using dye from juice of Randia cordata, Baphia nitida and Indigo dyes. These were also used to paint lovely designs on the face, body and hands. In the 1960s the art of body painting was brought within the reach of most people by the production of small stamps made from the fibre of bamboo sticks. They had typical patterns cut into them and were called 'ngurunguru' sticks (Oliver, 1960). These were purchased from the local market by men and women. For the Kalabaris and Efiks of Calabar and some Igbos, apart from the normal art of body painting in dances and other ceremonies, it was believed that a fat woman was beautiful and so young ladies took part in

the 'fattening-room' ceremony before betrothal. During this period of confinement, girls apart from being taught proper manners, took part in beautifying preparations and this included scarification and painting of her body using henna and other dyes. The skin was anointed with oils, hair coifured with special time and skill and a mixture of clay, charcoal and palm-oil made into a paste, rubbed into the hair. Camwood and Indigo dyes were also used to paint the body.

The Yorubas at one time coloured their hands, feet and nails by immersing them in pots of camwood, dyed up to the wrists and ankles. This gave them a red colour like that of the women of Egypt and North Africa who used henna. Kola was chewed to make the teeth brownish.

The Igalas had a custom of using henna to stain the hands and feet of a young girl in a public bath before being taken to her husband's house. It was also customary to add henna leaves and kolanuts to the warm water with which she was bathed. The end result was a shining and glossy skin.

Decorations of the face and body and manipulation of the hair had occupied the attention of both men and women for centuries. In most tribes, hair is that part of the body to which greatest attention was shown. Various symbolic coifures were displayed - there were

styles to identify a spinster, married women, barren and women in mourning. Pieces of false hair (wigs) was inter-twined with the natural hair. These false pieces were once of great importance. For instance, Fulani girls were given hair pieces passed from generation to generation and these they inter-twined with their own hair to form long plaits that hang loosely from their heads (Aishatu, 1965). Many of the olden days styles required the use of sticks to make a kind of bridge and these helmet-like shapes were formed by first oiling the hair, then rubbing a paste of camwood or clay mixed with soot and indigo. The hair was then rubbed with palm oil to give it a greenish-tinge and to make it sparkle in the sunlight. Such styles, common among the Yoruba and Igbo tribes, were often left untouched for several months. Each tribe was identified with a peculiar hair style-'shukus' were common among the Yoruba and Igbo tribes, the Kanuris had theirs from the centre of the forehead and arranged into a bunch on the head, the Fulanis wore their hair plaited and allowed it to hang loosely in thick and long braids adorned with ornaments. The Tsekiris of Benin wore theirs in a bond adorned with flowers.

Basically, variations in both the art of compounding and use of cosmetics among tribes varied only slightly. In different rural areas, there existed

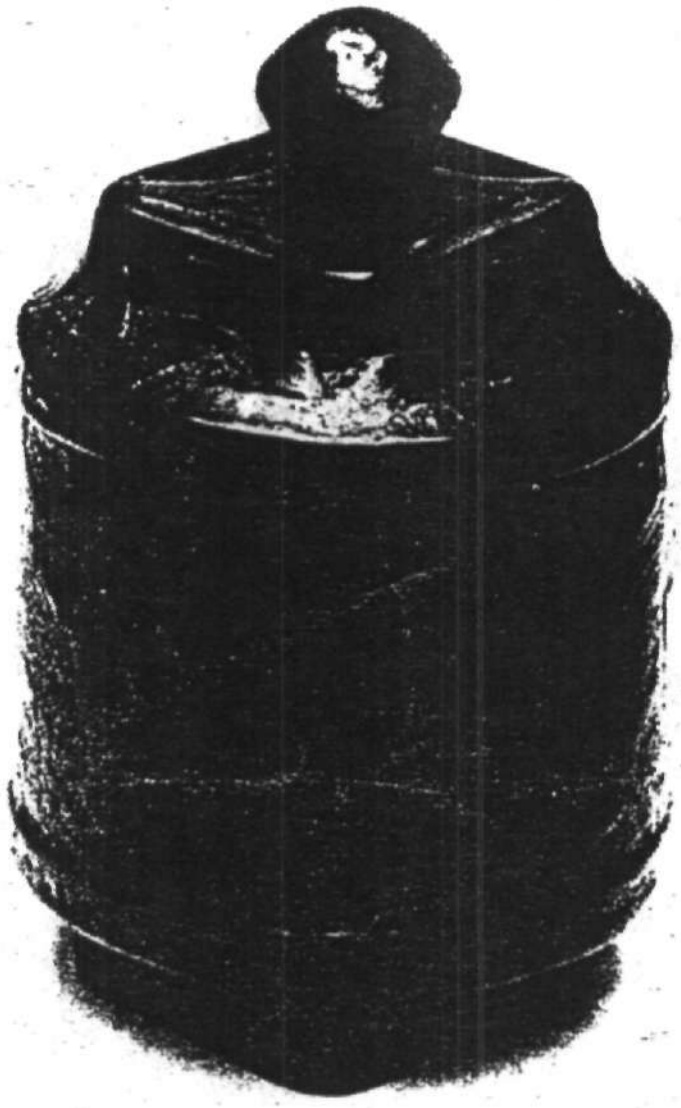


Fig. 3: Local container for storing camwood.

people who had thorough knowledge and skill in the art of cosmetics compounding - they compounded mainly body and hair creams and perfumes for Chiefs, Emirs and very influential people.

Formulations of such products were secretly kept and were exclusively stored in special cosmetic boxes. They included those for storing and mixing camwood, perfume bottles of all shapes and sizes and Ivory containers and sticks for galena (figs. 3 and 4).

Inclusive in the cosmetic boxes were mirrors adopted and adapted from Europe. These were elegantly set in carved holders (fig. 5). Shaving or plucking of unwanted body hair was common as these were considered ugly and indecent especially in women.

The already mentioned forms of decorations accomplished with paint, powder or herbs constituted the temporary make-up which symbolished a more transient state. There was also the permanent decorations resulting from scarification, tattooing, piercing and stretching of body. This symbolished a permanent role or status such as the process of initiation or achievement of a higher rank. Scarification then was a subtle language communicating symbolic, aesthetic and sensual meanings. Sometimes too, temporary scarification and tattooing were often done using escharotic or corrosive juices such as that of the corm of lily, Cyanastrum cordifolium, which when used to mark the body in form of fine black lines, lasted for about two months.

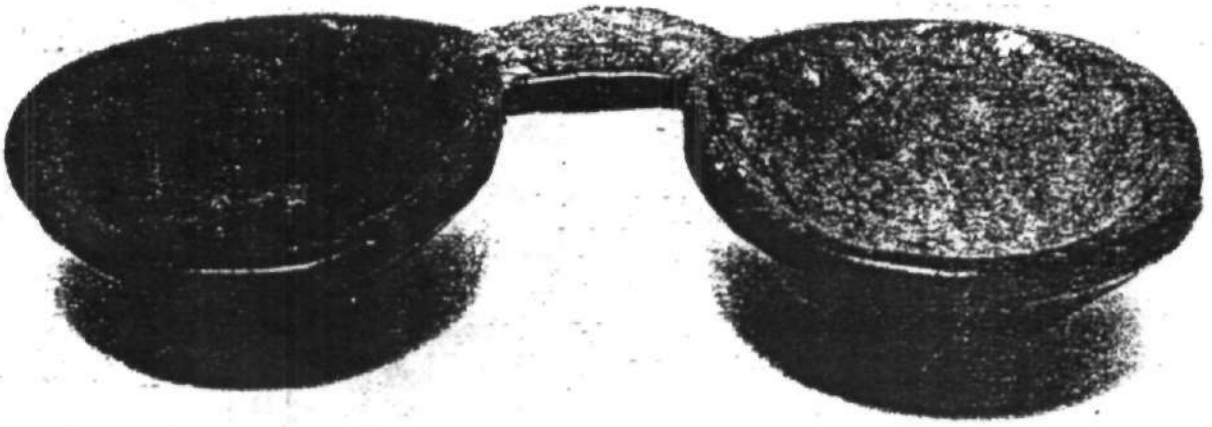


Fig. 4: Local container for mixing camwood.

Some Yorubas made ornamental markings with the corrosive juice of cashew nut and the juice produced by some small insects living on Burweed, Triumfetta rhomboidea. These marks rubbed with lime juice raised the skin in wheals without scars and the pattern lasted for weeks. More generally used, however, were stains which did not last long like the black cosmetic, 'katambiri' (common among the Fulani and Hausa tribes), prepared with seeds of local Gardenia erubescens or Randia maculata seeds. They were prepared by crushing the seeds with a little water and grinding to a paste on a stone (Aishatu, 1985). In other parts of Northern Nigeria, crushed leaves of Black plum, Vitex cienkowskii mixed with sugarcane juice or Guinea peach, added to the paste made them more lasting. Ready to use forms of such products were often on sale in local markets. In other areas, black stains of Cremaspora triflora, Feretia canthioides, roots of Cassia podocarpa, reddish stains from camwood, Bixa orellana, bark of Sarcocephalus diderrichii or extract of straw of Guinea corn (Sorghum caudatum) were all used.

White stains or paints were specially used during secret society ceremonies and folk dances. These were prepared by mixing an oil from Mahogany nut, Afrolicania alaeosperma, with dried white clay. While white paints were used by almost all tribes, sometimes red, or yellow colours were applied in rings round the eyes to avoid the 'evil eye' (in Northern Nigeria). Others when

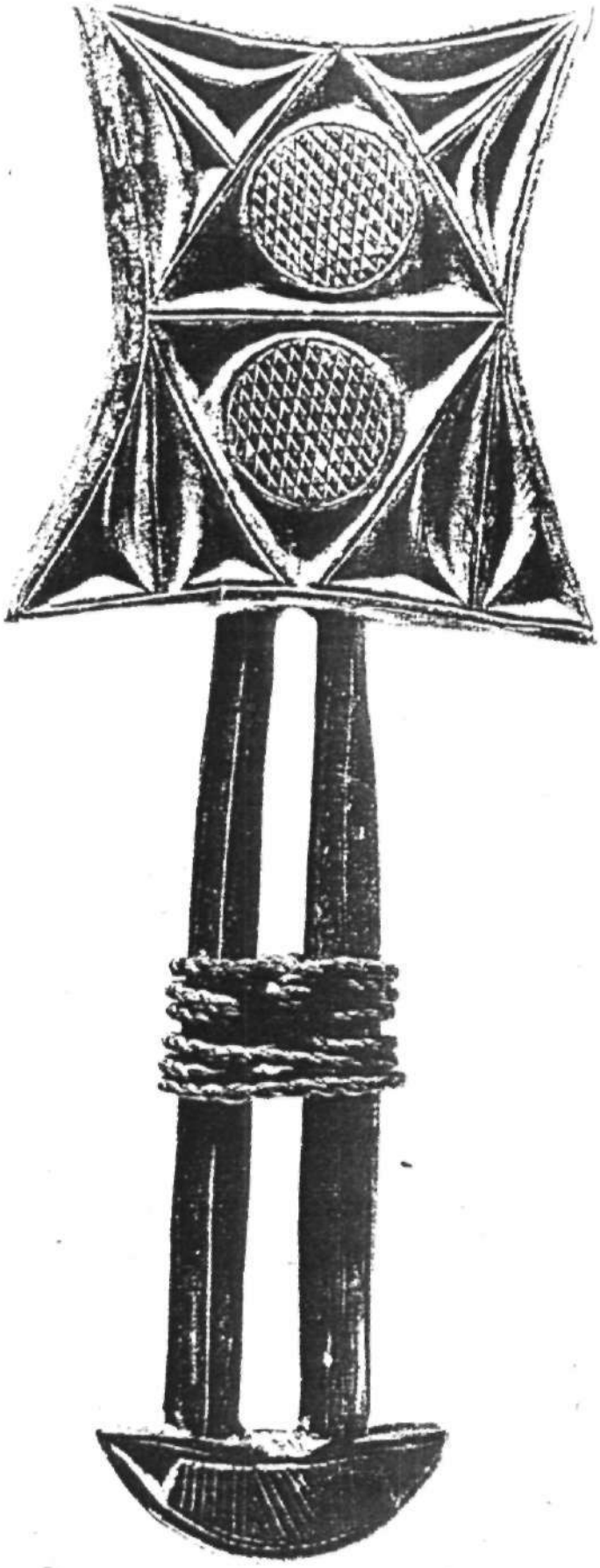


Fig. 5: Loca[illegible]or set in carved l[illegible]ers used among the Igbo tribes.

used were believed to make the wearer irresistable. In smearing these paints, face sticks from Heeria insignis were used.

Nigerians and the Modern Cosmetics

With the ever-increasing accent on youth, there is more interest than ever in cosmetics. In the past, cosmetics were regarded very much as a camouflage to hide the ravages of time and now with the increasingly scientific approach to beauty, research chemists spend their working lives perfecting creams and lotions that will keep the skin supple, younger and prevent wrinkles and effects of ageing.

The cosmetics of yester-years used and developed throughout the centuries have not changed much from those of today in the 20th century. The composition of cosmetics remain basically the same in most places. Plants used long ago have been more refined and are also used in today's natural cosmetics. The Nigerian of today, like his/her counterpart in other parts of the world, is aware of the latest development in cosmetics - what to use, when to use it, how to apply it and so on.

Unfortunately, the Nigerian male or female who uses cosmetics depends on the importation from other countries. Because of the awareness and desire by men, women and people of all ages to promote attractiveness

demand for imported cosmetics has gradually risen. The demand is expected to increase.

1.3 CONSUMPTION OF COSMETICS IN NIGERIA

No official record is available to determine sales of cosmetics in Nigeria. However, a data collected by the Cosmetics, Toiletry and Fragrance Association (CTFA) indicated an apparent phenomenal growth for the cosmetics and toiletries in the United States (Balsam and Sagarin, 1974). From 1914 to 1970, sales increased over one hundred times. For 1964 alone, CTFA showed a sales record for the cosmetics and toiletry category at $3.5 billion and $2.27 billion respectively in value of manufacturers shipment. The sales of cosmetics has been correlated to population increase. For example, in 1914 the population of continental U.S. was about 100,000,000 and sales of cosmetics was about $40 million. By 1970, about $4.6 billion was spent by some 206 million Americans. The field of cosmetic users and uses are expected to continue increasing.

This trend is also apparent in Nigeria. Cosmetics is one of the vast range of consumer products for which there is an increased demand in Tropical Africa (New Nigerian, 1985). According to a report produced by the Tropical Africa Advisory Group (TAAG), the export market for the products have remained virtually untapped.

With such a demand for cosmetics, it is necessary to develop a line of local production to cater for the numerous consumers and to conserve foreign exchange.

1.4 COSMETICS FROM NATURAL SOURCES

Modern cosmetic technology has come to recognise the 16th and 17th century use of herbs and their beneficial effects on the appearance. Herbs have been known to brighten hair and erase wrinkles and many other disorders. A famous French beauty was alleged to have retained her youthful appearance, so that at the age of 70 years, young men fell passionately in love with her. Her secret was the use of herbal bath and cosmetics.

There is a new awareness of the harm and damage that can be caused by the use of wrong ingredients in cosmetics. The damages often arise from the harsh chemicals used in formulating them. The gifts of nature apart from the curative properties are also applied to cosmetics and beauty. This has paved way for the development of natural or herbal products for the cosmetic care of the skin.

Scientific research has provided very effective natural ingredients that have the ability to maintain and protect the beauty and youthfulness of the skin as well as prevent and cure many skin problems. It has also been revealed that natural cosmetic products lack the side effects of certain synthetic chemical

(Aisida, 1985). Natural remedies are therefore important new concepts in the sphere of beauty, even though such methods existed in ancient times but were buried beneath the efforts towards 'modernisation'.

Nigeria is one of the countries blessed with a lot of natural raw materials that can be used in the cosmetic manufacturing. It is therefore time for the effective exploitation of such raw materials especially in this era of a slump in the economy and limited foreign exchange. There is also the need to develop a line of cosmetics using the abundant natural raw materials that will be most suitable for our tropical weather and skin.

In this context, an effort has been made in this project to identify some indigenous natural resources which are and can be used successfully in the formulation and preparation of cosmetics and other skin preparations. Identification of the sources are mainly based on existing literature and information collected from local traditional medical practitioners. Some information was also obtained from the elders of the society and folkore uses of plants as cosmetics.

A few experiments listed below have been carried out to evaluate some of the plants and their products used in the preparation of cosmetics.

(1) Extraction of volatile oil from some local plants to determine if future exploitation of local plants for manufacturing cosmetics will be a worthwhile venture.

(2) Macroscopical and microscopical studies of the three Eucalyptus species, namely, Eucalyptus citriodora, E. tereticornis and E. camaldulensis with a view to establish some pharmacognostic features which may be used for differentiating between them.

(3) Composition of the volatile oils using tlc and gas chromatography.

(4) Antibacterial effects of the volatile oils with a view to correlate the uses of some of the oils in local cosmetic preparations.

CHAPTER 2

2. REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1 DIFFERENT CLASSES OF COSMETICS AND PLANTS USED IN THEIR PREPARATIONS

SKIN PREPARATIONS

The use of salves and unguents for preserving and beautifying the skin dates back to earliest antiquity. They were originally prepared by digesting aromatic gum-resins, roots and flowers with fats and oils.

In the second century A.D. the first notable change in the constitution of these cosmetics was by the Greek Physician, Galen, who added water to his salves and by so doing laid the foundation of modern cold and cleansing creams.

Although all cosmetic preparations are intended for application to the body, those that often demand greater attention are those for facial skin. Skin preparations may be classified into two groups:

(1) Those used for skin care to supplement the natural function of the skin, to improve its health and condition and also to prolong its youthful appearance. These include body creams and pomades and those used to cure or prevent skin disorders;

(2) Make-up preparations which are intended to provide decorations. These include those used to make decorative marks or tattoos which often lasted for months or weeks.

In both categories, a plant part or combinations of plant parts may be used.

The seeds of many plants yield oils which form the basis for most skin pomades. To serve this purpose, the oil must be emollient. A host of important plants which yield useful oils for this function include: The palm kernel oil obtained from the nut of Elais guineensis (palm tree). This oil contains capric, capyrilic, lauric, oleic, stearic, myristic, palmitic and linoleic acids as constituents (Jamieson, 1946).

The oil is useful as an emollient and vehicle in cosmetic preparations (Opakunle, 1983).

In general, palmitic acid is used with stearic acid for the preparation of foundation creams (Poucher, 1974).

Oleic acid is a yellowish liquid and, when blended with the oil phase of cosmetic emulsions, produces a soft-textured emulsion with skin penetrating properties. The liquid expressed from the heart-wood of the palm tree is used in preparing cosmetic and beauty creams and hair lotions (Sceopul, 1966).

Hydrogenated interesterified palm oil is also used in cosmetic preparations according to Albo (1961) because it possesses constant physical and chemical properties: skin - lubricating, hydrophillic and

anti-rancid properties. It is also useful in lipsticks, rouges and creams for protection against retraction and maturing.

It is recommended for use in lotions, powders, ointments and pharmaceuticals in place of lubricants like glycerol, sorbitol or glycol.

Oil obtained from Persea gratissima (avocado pear) has been known and used by Mexican and South American women to protect the epidermis.

Avocado is found in the southern parts of Nigeria. The oil is hydraulically expressed at a high pressure from the fruits. The oil, which has a green colour or tint, impart this attractive colour to cosmetics and it is well-liked by many cosmetic manufacturers.

The bulk of the oil consists of 77% glycerides of oleic, and 11% of linoleic acid and vitamins A,B,C and D (Poucher, 1974).

The oil, apart from having excellent keeping properties, has the following properties which makes it an interesting cosmetic constituent:

(i) It has a high oil soluble vitamin content.

(ii) It has the tendency to reduce the surface tension of liquids thus forming finer emulsions.

(iii) It has exhibited skin healing properties.

(iv) It is rich in lecithins and phytosterine.

(v) It is one of the most penetrating oils known, and compares favourably with lanolin in this respect. It is thus valuable in tissue massage creams, muscle oils and other products where lubrication and penetration are essential.

Therapeutically, vegetable oil creams are more desirable than mineral oil creams and are more soothing to the skin.

Coconut oil, obtained from the kernels of the nuts of Cocos nucifera (Coconut palm) by expression, which has a charasteristic odour and emollient properties, is used in toiletries and body cream preparations (Poucher, 1974). It is composed of lauric, myristic and fatty acids (Poucher, 1974). Myristic acid is used to prepare esters of alcohol used in cosmetics (Jamieson, 1946). The oil is also used in hair pomades and shampoos because it enriches the scalp and hair growth is encouraged (Aishatu, 1985).

Other derivatives of coconut oil like the coconut monoethanolamide, which is a cream coloured waxy material, is used as a foam booster and stabilizer in the formulation of hair shampoos (Poucher, 1974). The fatty acid monoisopropanolamide derivative is also a cream coloured material. It is used in a concentration of from 2 to 5 percent as a foam regulating additive for detergents and shampoos.

Jamieson (1946) gives the constituents of shea butter oil, derived from Butyrospermum parkii (shea butter tree), as myristic (0.4%), palmitic (8.5%), stearic (35.9%), oleic (49.9%) and linoleic (5.3%) acids. The extracted fat, which consists of saturated glycerides, is used as a cream base and medicinal ointment (Aishatu, 1985). The shea butter oil is used as a base in cosmetic creams, ointments and pomades (Dalziel, 1937).

Dalziel (1937) states that the oil obtained from the seeds of Khaya senegalensis is used as body and hair pomades. According to Aishatu (1985), the oil also cures body disorders like pimples.

Peanut oil is derived from Arachis hypogaea (groundnut). Its constituents include arachin and oleic, linoleic, stearic, palmitic and lignoceric acids (Jamieson, 1946). It is used as a solvent base for ointments, cold creams pomades and as a massage cream (Duke, 1981). It also serves as a substitute for olive oil in cosmetic creams and as an anti-wrinkle. Olea longifolia (olive tree) is the source of olive oil. Even though the plant is not known to grow locally, it can readily be obtained from areas of the Mediterranean. There is however a species of olive which grows in Nigeria on the Bauchi Plateau (Dalziel, 1937). The seed of Canarium schweinfurthii (the olive species) yields oil which is sometimes used as shea-butter substitute. The sticky oleo-resin obtained

from the plant, ground with shea-butter or coconut oil is used for rubbing on the skin. It may also be used in making medicinal ointments.

Olive oil contains oleic, linoleic, palmitic and stearic acids, carotenoids and vitamins (Duke, 1981). The oil is superior to mineral oils in penetrating power. It is also used in lip-sticks, face powders as well as body massage oil and as an anti-wrinkle (Winter, 1976).

Olive leaves extract and olive oil when used in creams and other skin preparations are beneficial to the skin due to its emollient properties. It is also used in massage creams and as an anti-wrinkle (Winter, 1976).

Theobroma cacao (cocoa tree) is the source of cocoa-butter. The tree grows mainly in Western Nigeria and is one of the most important economic plants in Nigeria. Its economical exploitation has drastically reduced. Cocoa butter contains glycerides - oleopalmito-stearin, oleodi-stearin and palmitodiolein (Jamieson, 1946). It is used as a base in cosmetics. Cocoa-butter oil is also of pharmaceutical importance as a base for suppositories. When used as a cosmetic base, cocoa-butter oil keeps the skin supple and helps to protect the skin. This is due to its emollient and moisturizing properties (Poucher, 1974). Its use in cosmetics is desirable as it has a melting point of 34 - 35^{o}C, just

below body temperature. Adansonia digitata seed oil may be used as a cocoa-butter substitute (Jamieson, 1946).

Other plant materials which belong to this category of cosmetics include the milk of Bambus vulgaris, the bamboo tree. The bamboo milk, 0.05 to 20% (Roger and Gallet, 1965), added to skin cosmetics protects the epidermis by hydrating the skin. It is also used in facial, hair, shaving and dental preparations. Milk extract of bamboo shoots contain sucrose, fructose, vitamins B and C as some of its constituents (Roger and Gallet, 1965). Sceopul (1966) found products containing bamboo milk together with lanolin, glycerol and perfumes to be a hair stimulant and skin protector.

Corn oil from Zea mays (maize) and soybean oil from Glycine max (soybean) have emollient properties and are used as solvent for liniments, ointments and creams (Poucher, 1974). Corn oil contains oleic, linoleic, palmitic, stearic, arachidic and lignoceric acids (Jamieson, 1946). The stearic acid constituent can be used as a base in preparing vanishing creams (Poucher, 1974). The soybean oil has constituents composing of oleic, linoleic, stearic and linoleric acids (Jamieson, 1946).

For the maintenance of a youthful, beautiful and healthy skin, plant materials used included the decoctio of yellow flowers of Cucurbita pepo, the pumpkin. As a

general skin preparation to cure certain skin diseases, the boiled bark of Piper guineense, which yields a soapy product, was used to anoint the body. Piper guineense has piperine (Olaniyi, 1985) as one of its constituents. Piperine has antibacterial action (Olaniyi, 1985) which may perhaps be the explanation for the use of Piper guineense in local skin preparations.

Other plants included in this category are the crushed seeds of Uvaria afzelii which contains Uvafzelin (Olaniyi, 1985). Uvafzelin also possesses anti-microbial action. Scented leaves of Heinsia pulchella mixed with white clay, oil of Carapa procera (monkey cola), which is a source of 'crab - oil', and the roots and pulp of Strombosia grandifolia were used. They were often beaten and mixed with palm oil to make salves which cured shrivelled skin and withered hands and feet (Dalziel, 1937). The oil of Ongokea klaineana and pounded seeds and pulp of Popowia diclina (source of cape oil) mixed with palm oil was used as a salve too. A paste made from Baphia nitida and palm oil was used on the skin to beautify and cure skin disorders. Baphia nitida contains santal, pterocarpin and homopterocarpin (Duke, 1981). It may also have some antiseptic properties.

In addition, the paste of Pterocarpus erinaceus or Pterocarpus soyauxii made by triturating the wood

and mixed with palm oil was used. Also of use were oil extracted from Trichilia emetica and Ongokea klaineana.

For the maintenance of a healthy and beautiful skin, skin eruptions must be prevented. This form of skin eruptions are pimples and eczema. Certain plants were used to cure and prevent these outbreaks.

Tea extract may be useful in the treatment of large pores or black pores which is due to excess sebum, because of its astringent properties. Excess sebum secretion may lead to the outbreak of pimples. The caffeine and tannic acid components of the extract is responsible for its tonic, astringent and stimulant properties (Winter, 1976). Natural cosmeticians use tea extract for eye lotions also. Oil of tea leaves is used as germicide in cosmetics. It has skin healing properties and is known to penetrate the skin quickly (Winter, 1976).

A cosmetic preparation containing the juice of green bananas is useful against eczema and skin eruptions. When used in skin creams, it serves to eliminate wrinkles (Lechat et al, 1968).

The seeds of Monodora tenuifolia, roasted and grounded, was used on the skin to cure eruptions. Leaves of Veronia amygdalina (bitter leaf), bark decoction of Vitex micrantha and the dried pulverised bark of Avicennia africana mixed with warm water were used. Also a

liniment made from the later and the flowers and bark of Psorospermum guineense boiled (it gives a soapy product) was used against skin eruptions. Also used were the pounded yellowish-red resin of Vismia leonensis, sap of Garcinia kola and the sap and bark shavings of Pentadesma butyracea. The granular fat extract of the Pentadesma butyracea, which consists of oleic, palmitic and stearic acids (Jamieson, 1946), was sometimes used.

The root bark of Bridelia ferruginea and the oily extract of Jatropha curcas was used to prevent skin eruptions and other diseases.

In this category are also included the red sap of Manniophyton fulvum, decoction of whole plant of Sapium grahamii and crushed seeds of Physostigma venenosum (Calabar bean). Others were the leaves of Cardiospermum grandiflorum, infusion of bark and roots of Lannea acida and charcoals obtained by burning the roots and bark of certain plants. The charcoals were incorporated into skin ointments and pomades. Infusion or decoction of Mitragyna inermis and Xylopia acutiflora were also used.

The use of the above mentioned plant parts to cure or prevent certain skin disorders may be due to certain constituents in them that perhaps exhibit some antiseptic or possible bacteriostatic or bactericidal effect.

In the second category of make-up preparations intended to provide decorations in the form of paints, marks or tattoos are included a number of dye and juice producing plants. Of notable use in folk dances was the reddish dye material, bixin, obtained from Bixa orellana. The powder obtained from Baphia nitida was also used. Root-latex of Sapium grahamii and Cassia alata, which contains chrysophanic acid (Duke, 1981), have vesicant and escharotic properties and was used to tattoo the face to make it more attractive. The juicy Cassia alata leaves was used to colour the face red. Burnt gum of Canarium schweinfurthii, juice of fresh fruits of Rothmania whitfieldii, which is a source of a blue-black dye, finely grounded, stained the skin blue-black.

Irvine (1961) includes Terminalia cattapa (Indian almond), roasted seeds of Mallotus subulatus, the unripe fruit of Cremaspora triflora, fruits of Feretia canthioides, Gardenia erubescens, Gardenia vogelii and Randia maculata, all of which produced a kind of dye that was used as skin cosmetics. The plants when used on the skin produced colours after some days of exposure. The colours which may be fast on the skin, often remained for days, weeks or sometimes months. Perhaps, the dyes have some kind of affinity for protein of the skin.

Other plant materials exist which are also used to make specific creams for the skin, especially the face. Such materials include carotene, obtained from carrots and tomatoes. They find application as active ingredients in rejuvenating cosmetics such as creams for the reduction or elimination of wrinkles. In the form of carotene, vitamin A possesses a greater local activity, and in oil solutions is more readily absorbed through the skin (Poucher, 1974).

Cucumber juice is incorporated into cucumber creams and is a natural cleanser. It has a good surface healing and astringent properties (Winter, 1976) to rid the skin of oiliness, blemishes and infections. It also produces a cooling and soothing effect on the skin.

Chlorophyll, the green colouring matter of plants, is also used in creams because of its natural antiseptic and healing properties (Poucher, 1974).

The colourless and inodourous Grape seed oil contains linoleic acid (Poucher, 1974) and is a rich source of vitamin F. It is therefore used in vitamin creams.

A popular Nigerian plant, Azadirachta indica (neem), used to cure malaria, is a source of margosa oil (Oliver, 1959). It is known to have antiseptic properties and is used in conjuction with other body creams to cure parasitic skin diseases.

A pharmaceutical obtained from the juice of peels of green bananas has been found useful as a dermatological and therapeutic agent against eczema, skin eruptions, chaps and burns, and in skin cream against wrinkles (Lechat et al, 1968).

HAIR PREPARATIONS

Hair Shampoos

These are preparations designed to provide sufficient cleansing power together with adequate foam to remove soil or dirt from the hair and scalp without seriously reducing the natural oiliness, so that the hair is left with a natural gloss and in a soft and manageable condition.

Apart from the general cleansing action of shampoos, they are often formulated to care for different types of hair, like adding body to fine hair or they may be designed to cure scalp disorders. The scalp pathological conditions such as lice and dandruff, are characterised by the epidermal shedding of the scalp in dry flaky scales.

The use of any herbal shampoo is based on the saponin products of the plant (Winter, 1976). Saponin is a class of substances that are found in many plants. They produce foam or sud in water (Winter, 1976).

Eugenia caryophyllata (clove) was commonly used as a hair wash and tonic by the Kanuris (Dalziel, 1937). They called it 'tap-tap' and the hair wash was made by beating the cloves with water (Aishatu, 1985).

Grewia carpinifolia also was used by the local people as a hair shampoo (Dalziel, 1937) and the bark of Cola digitata, beaten with water, produced a foamy mass that, when rubbed on the hair or used as hair-wash, helped in curing baldness (Dalziel, 1937).

Tetrapleura tetraptera has a soft pulp which contains among other things saponin (Dalziel, 1937). It forms a soapy solution and may have been used as a hair wash.

Oil obtained from Cocos nucifera (coconut palm) has abundant lather and it is therefore an important component in shaving and hair shampoos (Poucher, 1974).

Extracts of carrot seeds have been found beneficial in hair shampoos (Prokopchuk et al, 1969) The extract has anti-parasitic and antibacterial properties (Prokopchuk et al, 1969) and so may be useful in curing dandruff and lice.

Juice obtained from lemon peels are often incorporated into hair shampoos or rinse for shine (Jamieson, 1946). Because of its antibacterial effect, it is used as an anti-dandruff too.

Oil from Eucalyptus species have citronellol, citronellal and cineole (Penfold and Willis, 1961) among its constituents. The cineole component has antiseptic properties (Penfold and Willis, 1961), which makes it useful as a component of medicated hair shampoos to cure parasitic conditions (Poucher, 1974).

Avocado oil from Persea gratissima is also recommended for hair shampoos as it is regarded as a hair restorer (Poucher, 1974). The leaves of Ipomoea batatas, the sweet potato, is used in Ghana as a hair-wash for lice (Irvine, 1961).

Hair Dyes or Colourants

Other hair preparations exist which are used when a change in hair colour is desired. They are mostly used to conceal grey or whitish hair. This group of preparations called dyes are often formulated in shampoo forms, though some may be in the form of hair pomades.

In ancient Egypt, it was a common practice among men and women to use a variety of dye - producing plants to tint the beard and hair. One of the commonest plants used from earliest times is Lawsonia inermis, the henna, which has many synonyms such as camphire, cypress shrub and Egyptian privet (Cox, 1938).

Henna contains about 1.0% of a colouring matter called Lawsone (Cox, 1938). It is this colouring matter that is responsible for dyeing the hair. But this can only be achieved in an acid solution.

According to Winter (1976) the use of henna as a hair dye is rather messy. To use on the hair, a paste is made by mixing the henna powder and water. Dalziel (1937) states that henna mixed with indigo gives hair a fine blue-black gloss.

In Nigeria, the commonly used dye-stuff was indigo obtained from species of Indigofera errecta, I. tinctoria, I. suffricotosa and Lonchocarpus cyanescens. The indigo dye, one of the oldest known dyes, has indigotin as the colouring ingredient (Polakoff, 1982). In air, this is oxidised to a blue-black colour. Thus when used on the hair, a blue-black colour is imparted to it. The use of indigo dye causes no known skin irritation, but its continuous use on the hair makes it brittle (Winter, 1976).

Numerous other dye - producing plants used included the seeds of Citrullus colocynthis. The black seeds of the plant yield an oil which is used to dye the hair black (Irvine, 1961). The leaf extract of Eclipta alba, fruit decoction of Randia maculata, leaf decoction of Ipomoea repens, Lonchocarpus cyanescens mixed with 'shunne', the blue dye used to

dye clothes and pods and seeds of Piliostigma thonningii all furnish blue-black dyes used to dye the hair (Dalziel, 1937). The leaves of Griffonia simplicifolia yields a black dye (Irvine, 1961) and is also used as a hair dye. Others are the leaves of Physostigma venenosum (Calabar bean), Terminalia cattappa (Indian almond), Garcinia mangostana and the gummy fruits of Desplatzia dewevrei. The juice of Hibiscus rosasinensis, Alchornea cordifolia, the bark of Jatropha curcas, the roots and bark of Phyllanthus muellerianus were used as hair colourants. Fruit extracts of Phyllanthus muellerianus was also used as setting lotion for the hair (Irvine, 1961).

Hair Pomades

A number of plant seed oils have been used to rub the hair which, when dry, dull and brittle, acquires a natural shine or gloss without any appearance of oiliness.

Most of the oils used as a base for skin or body pomades (cf. Skin preparations) are also used for hair products.

Attention will however be given to those hair preparations that are used to stimulate hair growth or those used to cure dandruff and hair lice.

The sour sap of Anona muricata and its seeds which contain 45% of a yellow non-drying oil with

irritant and poisonous properties was used by the Indians to cure hair lice (Irvine, 1961). Powdered seeds of Monodora myristica (the nutmeg), bark decoction of Pachypodauthium staudtii, leaves of Heinsia crinita, pulverised bark of Avicennia africana mixed with palm oil, fruits and seeds of Physostigma venenosum (Calabar bean) mixed with palm oil, seeds of Dioclea reflexa, leaves of Tephrosia vogelii crushed and prepared with indigo, and leaves of Androsiphonia adenostegia have been reported to be important in curing lice and dandruff (Irvine, 1961).

A host of other plants which include Mitracarpum verticillatum was used by women for parasitic conditions of the scalp (Dalziel, 1937). Bark infusion of Pentadesma butyracea, Cassytha filiformis, oil of Lophira alata and the latex of Euphorbia lateriflora, were also used by Hausa women to remove hair lice (Dalziel, 1937). Inclusive also were powdered leaves, fruits and seeds of Heteropteris leona (Irvine, 1961) and oil from seeds of Azadirachta indica (neem) (Dalziel, 1937).

The use of the above mentioned plants for curing lice and dandruff may be due to their antiseptic or anti-parasitic properties.

Neem seed oil, also known as Margosa oil, contains margosin and oleic, linoleic, stearic, palmitic and arachidic acids (Jamieson, 1946). The margosa oil is said to be antiseptic when used externally (Jamieson, 1946).

Also, the seeds of Gynandropsis pentaphylla rubbed with oil was used as a vermicide for the hair (Dalziel, 1937).

To lengthen the hair and cure baldness, the foamy mass of the bark of Cola digitata mixed with other hair pomades was rubbed on the hair (Dalziel, 1937). Oil from the kernel of Afrolicania aleosperma, cladodes of Asparagus africanus mixed with other hair pomades, juice of young shoots of Strophanthus hispidus and ashes of Pistia stratiodes (water lettuce) mixed with fresh cow butter (common among the Fulani tribes) were used to strengthen and lengthen the hair (Dalziel, 1937).

These plants may contain some constituents which help to strenghten the hair thereby preventing its breakage and encouraging growth.

Starch from the bulb of Urginea altissima, mixed with other hair oils and applied on the hair, made the hair to become stiff (Dalziel, 1937). Thus, the product may have been useful as a setting lotion.

Phyllanthus muellerianus was used among the Ubangis as a setting lotion (Irvine, 1961). Also red dye from Pterocarpus erinaceus was used to make certain hair coifures (Irvine, 1961).

Some oils which are useful in hair-dressing are oil of Lophira alata, Moringa oleifera and leaves of Sesamum alatum mixed with castor or other oils.

Moringa oleifera oil contains oleic (68.9%), linoleic (3.8%), stearic (10.89%), palmitic (3.6%), myristic (1.5%), behenic (6.3%) and lignoceric (0.13%) acids (Jamieson, 1946). These constituents could make it a good cosmetic base.

Apart from its use to cure parasitic scalp conditions, Cassytha filiformis is also used as a hair pomade because it is believed to stimulate hair growth (Dalziel, 1937).

Powdered leaves of Zizyphus spina-christa mixed in water was used for dressing women's hair (Irvine, 1961). It is also believed to darken and lengthen the hair.

Irvine (1961) also included oils of Carapa procera and Jatropha curcas as being of use as hair pomades. The latter oil is said to stimulate hair growth also (Irvine, 1961).

Olive oil obtained from Olea longifolia is used specially to treat dry scalps (Cole, 1978).

This last group of plants mainly serve to add shine and gloss to the hair.

PERFUMES: Historical Uses of Plants

For thousands of years, plants have been cultivated for their sweet fragrance or pleasant flavour. The odours of such plants are largely due to the volatile components

including acids, alcohols, esters, ketones, phenols, aldehydes and most especially terpenes. Usually the essential oils of flowers and leaves form the basis of perfumes.

The earliest records of perfumery use was to be found in Egypt where they were used for three quite distinct purposes:

(a) As offerings to their deities;

(b) For aesthetic purposes during their lives;

(c) As the principal agents for embalming their dead.

It was customary for the priests to burn incence before the gods in the temples and this incence probably consisted of aromatic gums, resins and oleo-resins mixed with perfumed woods.

In religious processions, there was a lavish display of perfumes and no King or Queen was ever crowned without being anointed with fragrant oils by the priests. At this period, the priests made most of the perfumes and fragrant oils and were therefore the perfumers of their time. Their pursuit was considered a mysterious and much-esteemed art. The perfumes were stored in beautiful containers of 'objects of Art', mainly made of ivory and albaster (see fig. 2).

The first oil produced was from refining castor pods which was rubbed by hunters to protect themselves from the sunlight (Angelolou, 1970). However, modern perfumes are made mainly for aesthetic purposes.

The Arabs are believed to have delved into the serious side of perfumery more than any other race. For instance, in the 10th century an Arabian doctor, Avicenna, made efforts to extract the perfume from flowers by distillation which was not quite understood at that time.

In Britain, the history of perfume and cosmetics in general was based on the importation of perfumes from the East by knights returning from their conquests. They brought back many much-prized toilet articles used by the ladies of the harem. This vogue quickly spread throughout France and Italy.

At the court of Queen Elizabeth of England, both sexes made use of every kind of aromatics for perfuming the body. The town of Grasse in France was and is still the seat of natural flower perfume industry. By reason of its ideal situation, this place has been able to maintain its premier position.

The Greeks held the use of perfumes in high esteem and the art was largely practiced by women. They believed that Venus, a god, was the first user of aromatics. The Romans in their early history showed very little interest in perfumes and it was only after their migrations into Southern Italy, then occupied by Greeks, that they acquired a more intimate knowledge of the aesthetic side of life. The centre of the perfume industry and perfumed oils in Italy was situated at Capua.

The Romans devised all sorts of beautiful containers for their perfumes.

The above mentioned nations are still the world's leading perfumers.

In ancient Asiatic and African nations, incence was burnt continuously in religious worships. Perfume-making was originally from burnt resin and scented woods.

In Nigeria/Africa, the fragrant bark of Boswellia dalzielii, slashed Canarium schweinfurthii, which exude a sticky oleoresin, and leaves and barks of Commiphora africana (African myrrh) were used as incence (Dalziel, 1937). The plant exude aromatic gum-resins, which when burnt as incence made the surrounding to be pleasantly scented. On distillation of the resinous substances essential oils can be obtained (Poucher, 1974).

Juice of Sarcocephalus esculentus along with astringent extract of pods of Acacia arabica or Acacia senegalensis were used for their fragrance. Acacia senegalensis exudes a gummy substance that is obtained by making an incision of the bark. Mixed with the bark of plants like Boswellia, it was used in the embalming process in northern Nigeria (Dalziel, 1937). Sometimes, the fragrant parts of plants like those of Lecaniodiscus cupanioides were used to prepare aromatic water or added to bathing water. On bathing with such water the skin is left with the fragrance of the plants.

Fragrant plant parts were also added to body or hair pomades to scent them. Examples of such plants included the wood and bark exudate of Copaifera salikounda. The pulverised seeds of the same plant were used as perfume, the aromatic crystalline compound being coumarin (Dalziel, 1937). Flowers of Dalbergia heudelotti, essential oil of Hoslundia opposita and the flowers of Jasminum sambac and Lawsonia alba were all used in pomades and oils (Irvine, 1961). Also used for scenting pomades was Tetrapleura tetraptera while the flowers of Plumeria acutifolia, leaves of Steganotaenia araliacea, leaves and oil of Acrocephalus lilacinus and flowers of Macrosphyra longistyla were used for local scent (Irvine, 1961).

Later the volatile oil of plants were extracted and used for making perfumes which were stored in containers specially made for them.

The distilled oil of Piper guineense, Acacia farnesiana and Eugenia caryophylata (clove) are used in today's perfume industries. Acacia farnesiana contains anisaldehyde, eugenol, farnesol, geraniol, benzoic acid and benzyl alcohol (Duke, 1981). Clove, which was used at one time to mask mouth odour (Aishatu, 1985),contains a phenol, eugenol (85%) (which is largely used in the synthesis of vanillin), eugenyl acetate, benzyl alcohol, methyl salicylate and a terpene caryophyllene (Wallis, 1967).

The clove plant is widely cultivated in Tanzania, Pemba and Zanzibar and were first brought there by the Arabs. Even though they are not cultivated in Nigeria, clove buds are sold widely in markets for their use as spices. As they tend to be very expensive, a perfume in which clove oil is used as a component may likely be expensive.

Volatile oils extracted by distillation from Eucalyptus species, especially Eucalyptus citriodora, Zingiber officinale (ginger), powder of Lawsonia alba (henna), Cymbopogon citratus (Lemongrass), Ocimum gratissimum and citrus fruits peels, e.g. orange, tangerine, lemon, lime, and grape fruits' peels are also important in modern perfumery. These plants contain constituents which make them to have characteristic odours. Eucalyptus citriodora is 'lemon-scented' and contains citronellal (about 65 - 80%), citronellol (15 - 20%) and esters (Penfold and Willis, 1961). Ginger oil, obtained by steam distillation from the rhizomes of the plant, yields up to 3% of volatile oil with a characteristic odour of ginger due to the gingerol content (Wallis, 1967). Other constituents are citral, linalol, d-borneol, esters, a phenol and a sesquiterpene alcohol (Poucher, 1974). The addition of the oil in traces to oriental perfumes gives a peculiar effect which is not obtained with any other oil. The result obtained is very difficult to imitate.

Lemongrass oil is of a pale sherry colour with a fragrant lemon-like odour. It contains 80% citral, citronellal, geraniol, methylheptenone, n-decyl aldehyde and probably linalol (Poucher, 1974).

Oils distilled from the Ocimum leaves and flowers have high phenol content. The phenols are mainly thymol or eugenol (Guenther, 1964). It also contains ocimene, a terpene. Other constituents listed by Guenther (1964) are linalol, carvone, geraniol and limonene.

The principal constituent of lemon oil is the aldehyde citral (4-6%) which consists of two isomers - neral and geraniol. Other constituents are d-limonene with traces of aldehyde, citronellal, terpineol, phellandrene, linalyl and geranyl acetates (Poucher, 1974). Lemon oil blends well with clove and other oils, and is much used in conjuction with citronellal and lemongrass oils.

Orange oil contains limonene with small quantities of linalol, terpineol, citral, citronellal, methyl anthranilate, nonyl alcohol and decyl aldehyde (Poucher, 1974). The oil is often used in the manufacture of eau-de cologne (aromatic waters).

The African orange oil according to Poucher (1974), possesses a very fine odour competitive with those from other parts of the world.

Citral and methyl anthranilate with large proportions of d-limonene are the chief constituents of lime and tangerine (Mandarin) oils respectively while grape fruit

oil is said to be 90% limonene, 2 to 3% oxygenated volatile sesquiterpenes and 7 to 8% of non-volatile waxy materials (Poucher, 1974). In the terpene free oil, octyl and decyl aldehydes, geraniol, cadinene and small quantities of citral and methyl anthranilate have been identified (Poucher, 1974). This oil has been found to offer a promising future in perfumery. It has also been found by Poucher (1974) to be acceptable in colognes - toilet waters and other perfumes where orange and lemon oils are employed. In particular, citral prepared from lemon and lime oils is most esteemed for high-class perfumery and about 0.1% added to rose compounds will impart a most delightful freshness. However, the citrus oils are used in perfumes in which floral odours, that is the odour of the flower, is desired.

In the long list of plants important in perfume - making are Daniella caudata, D. oliveri and D. thurifera. They consist of an oleo-resin called hardwickia or illurin balsam (Poucher, 1974). This contains about 50% of essential oil and is used to adulterate other oils.

Other plants used include oil of leaves of Anona senegalensis, fruits of Pimenta officinalis (rich in eugenol) and oil from Terminalia macroptera.

Sometimes, the plant parts were directly rubbed on the body as perfume (Aishatu, 1985). Examples of

such plants are the leaves of Strychnos odorata, pulverised leaves and shoots of Artemisia maciverae which was brought into Nigeria by the Arabs (Dalziel, 1937).

Of importance in today's masculine perfumes are Nicotiana species, which has the odour of tobacco. Distilled portions of the plant yield eugenol which is important in perfumery (Sabetay et al, 1941). For spicy odours, oil of Myristica fragrans (nutmeg) is used. It has eugenol borneol, linalol, geraniol, safrole, terpineol and isoeugenol as constituents (Poucher, 1974).

There are some plants whose oils are important in the perfume industry but are not native of Nigeria. Such plants like Jasmine and Roses may however be cultivated. There is evidence that they may grow well here as shown by their cultivation as garden flowers. Other plants like the Myristica fragrans does not grow in Nigeria, but it may be easily obtained.

MISCELLANEOUS

Face Powders, Eye Shadows and Lipsticks

A face powder is a form of cosmetics that is used to cover facial imperfections. By virtue of its covering power, the powder hides the colour of the part of the body to which it is applied, and gives

this part its own colour. This type of powder is a blend of sufficient colouring materials to give the desired tint and perfumes (Nostrand, 1976).

A number of covering agents are used. Talc is used to make the powder spread easily and is usually used to the extent of one-half or more of the total ingredients (Nostrand, 1976). It also imparts smoothness to the powder, both in use and in handling of it. Corn, wheat and maize powders are used as ingredients in face powders. The starch powders act as demulcents for the powders (Winter, 1976). The maize powder also finds use as a base in rouges.

However, rice starch, prepared from Oryza sativa, is used in cosmetic powders in preference to other starches on account of its comparative invisibility (Poucher, 1974). The granules are polygonal and uniform in size.

Some white pigments are necessary in face powders to absorb moisture and perfume. Precipitated chalk, starch, magnesium carbonate and kaolin are commonly used (Nostrand, 1976). Magnesium stearate also helps the powder to adhere, while the titanium dioxide and zinc oxide allow the powder to cover the skin more thoroughly because of their covering power (Harry, 1973). Nigerian chalk may be used in place of magnesium stearate or talc.

Colour is considered a primary factor in face powders. The colouring materials used are either natural ground earth or certified organic colours (Nostrand, 1976).

The perfume is added after the talc has been "prefixed" by a special treatment.

The face powder which is prepared in liquid form requires the presence of some mucillagenous substance for adherence, and bentonite clay to aid in maintaining the solids in suspension and to prevent caking on standing.

The main types of cosmetics in cake form are cake rouge, used to colour the cheek bones, and cake powders. A number of ingredients like talc, clay, zinc oxide, zinc stearate, dye, a small quantity of heavy mineral oil, and perfume are milled together for the manufacture of the cake powder and rouge.

Charcoal black, a black pigment consisting of charred substances like wood, are used in eye shadows, which are colours used on the eye lids. They are known to be non-toxic.

Lip sticks are almost universal cosmetics since, together with the eyes, the mouth is a leading feature, and can be attractively coloured, textured and seemingly changed in size to meet the needs of beauty and fashion.

The essential ingredients of lipsticks are oil, wax to make the oil semi-solid and colouring materials (Nostrand, 1976).

Castor oil obtained from the beans of Ricinus communis has been the favourite oil used. More than fifty percent of lipsticks in the United States use a substantial amount of the castor oil (Winter, 1976). The fatty base in lipsticks is firm and spreads easily. The mineral oil, 15% in amount (Nostrand, 1976), imparts gloss and has no other useful function. The flavour and odour of lipsticks are important, and are decidedly limited in choice.

Vanillin and ethyl vanillin are used for flavours while rose, jasmine and orange blossom are for odour, with the total amount of both about 2% only (Nostrand, 1976).

Lighter waxes of sugar cane are suitable as partial substitute for hard wax in lipsticks (Pokorny et al, 1963). Hydrogenated palm-oil is used in lipsticks due to its constant physical and chemical properties (Albo, 1961).

Lipstick colours may be provided by pigments, usually those red in colour, but titanium oxide, a white compound that gives brightness and colour to the lips may also be used. Stains which dye the surface of the lips may be used too.

Because lipsticks are placed on a sensitive surface and is ultimately ingested, they are made to the highest safety specifications. The ingredients must be blended so that it is easily applied, does not separate or sweat, does not crack or crumble, and stays on satisfactorily for several hours. It must not be irritating to the flesh, and should have a softening point not lower than 48°C nor higher than 63°C, the favoured range being 55°C to 60°C.

Products similar to lipsticks but with little or no colour are also used on the lips. They are known as salves and they lay a thick protective coating on the lips against the effects of wind, sun and extremely low humidities. They may be used simply to provide a glossy finish to lipsticks. Honey is an important component of lipsticks.

2.2 ADDITIVES USED IN COSMETICS AND THEIR PLANT SOURCES

Some plant materials exist which even though do not act as the main active ingredient in cosmetics, may all the same be necessary in their formulation. For cosmetics to appeal to consumers, they must be formulated in such a way as to serve the desired therapeutic, psychological or physiological effects. The additives such as colourants, flavourants, etc. provide these effects and may also help to prevent

the deterioration of the cosmetic preparations in which they are added. This is because they may possess some antifungal or antibacterial actions which will prevent bacterial growth.

Cosmetic Colourants

Colours impart an attractive look to the cosmetics which in turn attract prospective buyers. A number of plants produce dyes which may be of value in colouring cosmetics. Some of such dyes, e.g., red dye from Baphia nitida (camwood), apart from the physical action of colouring, is used on the skin to prevent bacterial infections on the skin (Dalziel, 1937). The waxy red material of Bixa orellana contains bixin (Trease and Evans, 1972). This pigment is orange in colour and may be of use for colouring.

Carotene is the yellow colouring matter of Daucus carota (carrots) and Solanum esculentum (tomato) (Poucher, 1974). It is extracted as a red crystalline powder and is used in cosmetic colouring (Winter, 1976). Carotene, a good source of provitamin A, helps to eliminate skin wrinkles when incorporated in face creams (Poucher, 1974).

Tectona grandis (teak leaf) is also a source of some colour that can be used as colourant (Olaniyi, 1985).

Poucher (1974) included the green colouring matter which occurs in leaves and stalk called chlorophyll as being of use as a colourant in some cosmetic formulations. Commercially, the chlorophyll used is obtained from Amaranthus caudatus (spinach) (Poucher, 1974) by percolation with volatile solvents. Chlorophyll has antiseptic properties. Other dye-producing plants which may be of possible use in colouring of cosmetics include Cochlospermum planchonii, which contains a yellow dye (Irvine, 1961) and C. tinctorium which also yields a yellow dye that was used locally to colour shea-butter oil used for body cream. Bark of Terminalia ivorensis, T. mollis, T. superba, Gossypium arboreum and Bombax brevicuspe all contain yellow-red dyes (Irvine, 1961). Also leaves and bark of Anacardium occidentale (the cashew nut tree) is a source of yellow dye (Irvine, 1961). Wood of Pterocarpus santalinoides, bark and roots of P. erinaceus, Haematoxylon campechianum and bark of Acacia senegal all contain red dyes (Irvine, 1961). Irvine (1961) also gives the list of a host of some dye-producing plants that could perhaps be of some use in colouring cosmetics: Cassia tora, bark of Casuarina equisetifolia, leaves of Mangifera indica (Mango) which all yield yellow colours and Cassia alata.

Cassia alata whose leaves yield a red dye contains a volatile constituent also called azulene

(Benjamin, 1980). The leaves are used as herbal remedies for the skin because of their antimicrobial action (Benjamin, 1980). The dye may also have this property. Other dye-producing plants that could be used as cosmetic colourants include bark of Adansonia digitata which yields a red dye, bark of Avicennia nitida (yellow dye), Borassus aethiopum (yellow dye), heart wood of Baphia pubescens (red dye), leaves of Anthonotha macrophylla (red, yellow or black dyes), leaves of Anogoeissus leiocarpus (yellow dye) and Artocarpus communis (yellow dye). Others are wood and latex of Bosquiea angolensis (red dye), barks of Bridelia ferruginea (orange, red and red-brown dye), Ceiba pentandra (red-brown dye), Chlorophora excelsa (yellow-brown dye) and young leaves and shoots of Bridelia micrantha which furnishes a red eye.

The bark of Zizyphus mauritiana yield a Cinnamon-coloured dye, bark of Zizyphus jujuba (brown and grey dyes), bark and leaves of Trema guineensis (brown dye), Tephrosia purpurea (orange brown dye) and bark of Tamarindus indica which yields yellow, brown or green dyes are also included. Some of these natural dyes have been used in traditional and modern cosmetic preparations as colourants.

FLAVOURING AGENTS

The development of flavours for cosmetics is an area which has not received much attention locally. However, the volatile oils often incorporated in cosmetics serve as the flavouring agents. Various constituents of the volatile oils are responsible for the characteristic odours, flavours and therapeutic properties of the oil.

Many volatile oils possess antifungal and antibacterial activities (Varro et al, 1981). Presence of the antiseptic oils prevent bacterial growth.

Apart from the volatile oils of leaves, certain fruits exist which produce such intense but pleasant odour that could be of some economic use in flavouring cosmetics.

Clove oil from Eugenia caryophyllata contains chiefly eugenol, vanillin and B-caryophyllene (Varro et al, 1981). Other oils used as such include oil of nutmeg from Myristica fragrans, lemon peels oil, orange flower oil and orange peels oil from Citrus aurantium and Eucalyptus oil. Myristica fragrans has myrcene, l-limonene, cineole and methoxyeugenol as constituents (Varro et al, 1981). The lemon peels oil has citral, l-limonene, B-pinene and γ-terpinene (Varro et al, 1981), while the orange oils have limonene, geraniol and pinene (Varro et al, 1981) as chief constituents. Irvine (1961)

listed the young leaves of Anacardium occidentale, Lantana mearnsii, Cordyline fruticosa and Blighia welwitschii as being of importance as flavouring agents which may also be used in cosmetics.

Others are roots of Carissa edulis, roots of Cochlospermum species, leaves of Cordyline fruticosa, leaves of Fagara xanthoxyloides, Morinda lucida, Tephrosia linearis, Tetrapleura tetraptera and Piper guineense. The constituents of the oil of the lather has antibacterial action (Olaniyi, 1985).

Thus flavouring agents may serve as preservatives for cosmetic preparations too because of their anti-bacterial action.

THICKENERS

For the physical and chemical stability of cosmetic preparations, e.g., creams and lotions, thickeners are necessary as additives. They help to stabilise emulsions, act as binders and thickeners of the products.

A number of gum-producing plants have been found useful in achieving one or more of the functions mentioned above.

Acacia senegal (gum Arabic) has been used for at least 4000 years when it was first shipped as an article of commerce by Egyptian fleets.

The gum is obtained in West Africa as an exudate from the Acacia plant. Whistler (1973) listed some of

the uses of the gum as follows:

It acts as a stabiliser of emulsions in lotions and protective creams, and a binding agent in the formulation of rouges, a coloured cake applied to the cheek bones, and compact cakes in powder form used to hide facial imperfections. The main components of the products are a coloured vehicle, mineral oil and an aqueous solution of the gum.

The gum acts as an adhesive in the preparation of facial masks and also increases the viscosity, assists in imparting spreading properties to cosmetics and adds a smooth feeling to the skin by forming a protective coating.

It is a foam stabiliser in the production of liqud soaps, e.g., shampoos for the hair. The non-oily fixatives of the gum improves the fixative properties without greasy stains on clothings.

The gum has advantages in cosmetic of being non-toxic and being free from dermatological and allergic reactions. It is also said to have the advantages of being odourless, tasteless and colourless (Winter, 1976).

Tragacanth, the gum tragacanth, has a long half life and film forming properties which makes it useful in hair lotions and creams formulation. Generally, 0.4 to 0.8% based on total weight is used in these applications (Whistler, 1973).

Ceratonia siliqua, the Carob bean gum (locust bean), has a gummy material in its seeds and this is the source of the commercial gum. In lotions and creams, it acts as a thickener and stabilizer. The gum consists of galactomann (83.05%) and pentosan (4.1%) (Griffiths, 1949).

Hibiscus esculentus, the okra plant, is a source of a gum obtained from the pods. The gum is composed of 14 amino acids, D-glucose, D-fructose, some uronic acid and protein (Whistler, 1973).

The gum, according to Whistler (1973), has emulsifying properties and may also be used as flavouring agent. The emulsifying properties make cosmetics to which the gum is added to be smooth and to have a creamy spread.

Tamarindus indica, the tamarind plant, has a kernel in which the powdered material used to make the gum is obtained. Whistler (1973) records the properties of the gum as being a stabilizer in oil emulsions, an adhesive, a thickener, an emulsifier and a builder.

In cosmetics, it is used to prepare emulsions of essential and fatty acids and shaving creams.

Cellulose, the chief constituent of the fibre of plants, is also used as an emulsifier in cosmetic creams and has no toxicity (Winter, 1946). Cellulose derivatives are also useful in cosmetics and they include:

(i) hydroxypropyl cellulose which is used in cosmetic emulsions because of its organic solvent solubility.

It is used as a thickener in solvent - based adhesives, alcohol - based hair - dressings and hair-growing aids, perfumes and colognes.

(ii) sodium carboxymethylcellulose which is used as a stabilizer and binder in cosmetic creams and hand lotions because of its grease resistance and vitamin-oil emulsions.

Dextrin, a gum prepared from starch in the form of a white or yellow powder, acts as a thickener in cream and liquid cosmetics (Winter, 1976). Corn and potato starches also act as cosmetic thickeners and colourants (Winter, 1976).

Pectins, found in ripe fruits and vegetables, have the characteristics of colloids which are alleged to have a beneficial effect on the epidermis. They are used as stabiliser and emulsifier; for essential oils (Whistler, 1973).

These last group of compounds have properties which will make cosmetics to be smooth and have a creamy spread so that it can easily be spread or rubbed on the skin without any friction.

CHAPTER 3

3. MATERIALS AND METHODS

3. MATERIALS AND METHODS

3.1 PLANT MATERIALS

(a) Collection And Identification

The Eucalyptus species namely Eucalyptus citriodora Hook., Eucalyptus camaldulensis Dehnh. and Eucalyptus tereticornis Sm. were obtained from the Savannah Forestry Research Station, Zaria, Kaduna State of Nigeria. The Cymbopogon citratus Stapf. (Lemongrass) was collected from the Police Barracks opposite new Kano Road, Zaria while the Ocimum gratissimum Linn. was collected from the Main Campus of Ahmadu Bello University at Samaru, Zaria, Nigeria. Zingiber officinale Rosc. (Ginger), Eugenia caryophyllata Thub. (Clove) flowers and the citrus fruits, Citrus aurantium Linn. (sweet orange) and Citrus reticulata Blanco. (Tangerine) were bought from the Samaru Market, Zaria.

The Eucalyptus species were identified by taxonomical means in the Savannah Forestry Research Station, Samaru, Zaria. Ocimum gratissimum and the Cymbopogon citratus were identified in the Herbarium of the Biological Sciences of Ahmadu Bello University, Zaria, Nigeria. Eugenia caryophyllata, Zingiber officinale

and the Citrus fruits were identified in the Department of Pharmacognosy and Drug Development, Ahmadu Bello University, Zaria by direct comparison with authentic samples, and by normal taxonomic means.

(b) Preparation for Microscopic Studies

Fresh leaves obtained from three Eucalyptus species namely Eucalyptus citriodora, Eucalyptus tereticornis and Eucalyptus camaldulensis were cleared by boiling in chloral hydrate solution for the microscopical studies. Both qualitative and quantitative microscopy were carried out on small pieces and sections of the leaves using dilute glycerol as the mountant.

(c) Preparation for Extraction of Volatile Oils

Both dried and fresh materials were used for the extraction. For the dry samples, all the specimens were left to dry in the oven at very low temperature for some days. They were then coarsely powdered manually by using a mortar and pestle and then weighed quantities of the materials were subjected to extraction. Fresh materials were directly weighed and then chopped to pieces before extraction.

3.2 QUALITATIVE MICROSCOPIC STUDIES

Small pieces and section of the Eucalyptus leaves which had been cleared using chloral hydrate solution were used. Glycerine solution was used as mountant. Standard methods (Wallis, 1967) of preparation and mounting were used.

3.3 QUANTITATIVE MICROSCOPIC STUDIES

Procedure used for these studies are outlined below. The reagents mentioned above were used.

1. Stomatal Number

A 1mm square was constructed on a plain sheet of paper using the stage micrometer. The camera lucida was adjusted so that the square was brought into focus. Pieces of leaves from the middle lamina were used. The slide with the prepared leaf sample was focused and made to superimpose on the square. The number of stomata and ordinary epidermal cells contained in the square were indicated by small crosses. This was done a number of times for different fields.

2. Palisade Ratio

Pieces of leaf, about 2mm square, were cleared using chloral hydrate. The mounted leaf piece was focused and the camera lucida arranged so that the epidermal and palisade cells are observed. The constructed square (1mm) was arranged so that the

slide superimposed on it.

A group each of four epidermal cells was traced on the square and their outlines made thick using a pencil. This was to make them more conspicous. The palisade cells lying beneath each of the four epidermal cells were then focused and traced. The palisade cells in each group were counted, including those that were half covered by the epidermal cells. Procedure was repeated for different fields.

3. Vein-Islet Numbers

A 1mm square was constructed and the cleared leaf piece was focused and by adjusting the camera lucida arranged to superimpose on the square.

Leaf pieces from the central part of the lamina were used. The veins in four contiguous squares were traced on the square. The vein-islets which were completely contained in the squares were numbered and then counted. This was also repeated a number of times.

4. Measurement of Stomatal, Epidermal and Oil-gland Sizes

An eye piece micrometer which was calibrated using the standard method (Trease and Evans, 1983) was used.

3.4 EXTRACTION OF VOLATILE OILS

Steam distillation (BP, 1980) method was used for the extraction of the volatile oils.

The accurately weighed quantities (70g to 1000g) of plant materials were used for the extraction. The distillation lasted till successive readings of the volatile oil distillate on the graduated receiver of the extraction apparatus remained constant. The oil yield from each of the plant samples was collected in test tubes, dried by using anhydrous sodium sulphate and stored in sample bottles. The bottles were then closed using aluminium foil before putting the cap to prevent oxidation. All the labelled oil samples were stored in the refrigerator until required for further use.

3.5 CHROMATOGRAPHY OF THE VOLATILE OILS

Thin-layer Chromatography (TLC)

System 1_T

Stationary phase: (a) Silica gel GF type plates (0.25mm thick)

(b) Alumina plates (0.25mm thick)

Solvent system: n-Hexane (100)

System 2_T

Stationary phase: (a) Silica gel GF type plates (0.25mm thick)

(b) Alumina plates (0.25mm thick)

Solvent system: Pet ether: ethyl acetate (97.5 : 2.5)

System 3_T

Stationary phase: (a) Silica gel GF type plates (0.25mm thick)

(b) Alumina plates (0.25mm thick)

Solvent system: Benzene: ethylacetate (95 : 5)

Visualisation

a. Vanillin/sulphuric acid reagent

b. Anisaldehyde/sulphuric acid reagent

c. Iodine vapour

d. U.V. light.

3.6 GAS-LIQUID CHROMATOGRAPHY (GLC)

Materials

Liquid phase:	OV_1
Support:	Chromosorb G (80 - 100 mesh)
Carrier gas:	Nitrogen
Detector:	Flame ionisation detector
Sample quantity:	0.2 microlitre
Temperature:	60-160°C

Methods:

The gas chromatography was carried out on Pye Unicam 124 model instrument. The glass column was of 2 metre length and 2 millimetre diameter. The column support was chromosorb G, 80-100 mesh.

The glass column was packed with one percent silicone rubber (S.E. 30). Injector temperature was about 40°C above that of the column temperature. The carrier gas (oxygen free nitrogen) was adjusted to 60ml/minute. 0.2 Microlitre of samples were chromatographed with a temperature programme of 60°C to 160°C rising at a rate of 6°C/minute.

Components of the oils were identified by co-chromatography with authentic oil samples.

3.7 MICROBIOLOGICAL STUDIES

Determination of Sensitivity of the Volatile Oils

Materials and Micro-organisms Used

1. Pipettes 1ml (sterile)
2. Cotton swabs (sterile)
3. Forceps (sterile)
4. Nutrient agar (plates)
5. Nutrient broth (tubes)
6. Sample bottles (sterile)
7. Petri-dishes (sterile)
8. Filter paper discs (sterile)
9. Sabaraud's liquid media (bottles)
10. Sabaraud's dextrose agar medium (plates).
11. The micro-organisms

Methods

The organisms were incubated in nutrient broth at 37°C for 24 hours, while the fungi were incubated in Sabaraud's liquid media at 25°C for 24 hours. After incubation, the density of the cultures was adjusted by diluting with nutrient broth and comparing with that of the opacity tube. The nutrient agar and Sabaraud's agar plates were inoculated by streaking with a sterile cotton swab.

Streaking was done successively in three different directions to obtain even inoculum. The

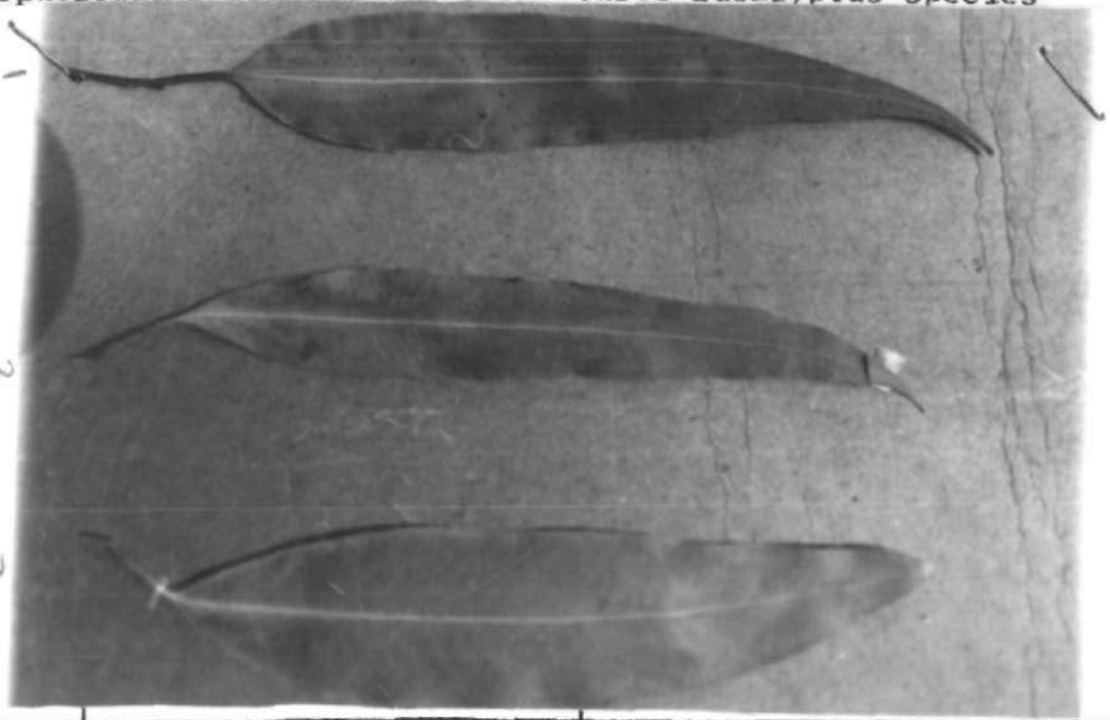
inoculated plates were allowed to dry for about five minutes at room temperature.

The filter paper discs were saturated with the oils and using a sterile forcep, the discs were then placed on the surface of the plates. The plates were left for about two hours at room temperature to allow for the diffusion of the oils, after which the nutrient agar plates were incubated at 37°C for 24 hours and the Sabaraud's agar plates incubated at 25°C for 24 hours. The sizes of the inhibition zones were then measured to the nearest millimetres.

CHAPTER 4

4. RESULTS AND DISCUSSION

Morphological Difference of the three Eucalyptus Species



alyptus tereticornis

Juvenile leaves	Opposite, petiolate, 2-3 x 0.5-1 cm or longer, lanceolate, rough surface with bristle like hairs, glaucous.	Opposite, petiolate, 1.5 x 0.5 cm, lanceolate, glaucous.	Opposite, petiolate, 0.1 x 0.1 cm, glaucous.
Adult leaves	Alternate, petiolate, 14.5 - 15.5 x 3 cm, lanceolate, rough surface, green colour, venation moderately conspicous, intramarginal vein not distinct from margin.	Alternate, petiolate, 14 x 1.5 cm, lanceolate, pale green colour, venation conspicous, intramarginal vein quite distinct.	Alternate, petiolate, 15 x 3 cm, lanceolate, green colour, venation conspicous, intramarginal vein distinct.

Key: 1. E. citriodora
2. E. camaldulensis
3. E. tereticornis

4. RESULTS AND DISCUSSION

4.1 COMPARATIVE PHARMACOGNOSTIC STUDIES OF E. CITRIODORA HOOK., E. TERETICORNIS SM. AND E. CAMALDULENSIS DEHNH.

The three Eucalyptus species possess many similar physical characteristics which make their identification difficult. The species also appear apparently similar in macroscopical characters. However, some macroscopical features such as the size, shape, margin and veinlet arrangement of the leaves may be used for differentiating between them (see overleaf).

The results obtained by microscopic examinations have been listed in Table 1 in a comparative manner using the appropriate headings to make references easier.

Other physical characteristics that may be useful in the identification and differentiation between them are the sensory characters of the powdered leaves. E. citriodora has 'citron' or lemon-scent and can easily be distinguished from the other two species, E. camaldulensis and E. tereticornis both of which have menthol-like odour. The powdered leaf of E. tereticornis has a bitter taste while E. citriodora and E. camaldulensis are bland in taste.

4.2 QUALITATIVE MICROSCOPY

Microscopically, the three species are similar in having:

(a) Straight anticlinal walls which are thickened.

(b) Numerious stomata on both lower and upper epidermises. The stomata are of the anomocytic type (see figs. 6, 7 and 8).

(c) Prismatic ca-oxalate crystals, sometimes with rosettes. They are often located on the veins and

(d) Presence of oil-glands.

There is complete absence of other features like trichomes and papillae in all of them.

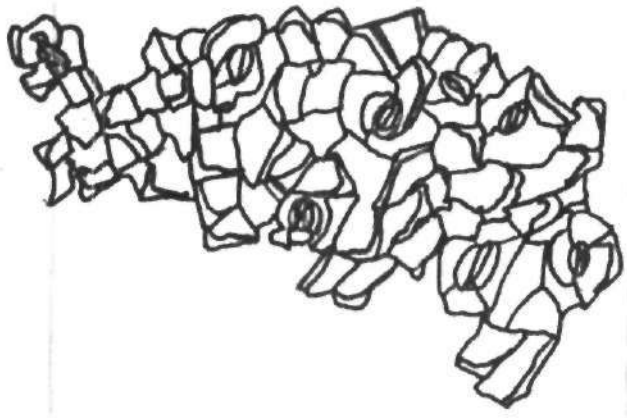
4.3 QUANTITATIVE MICROSCOPY

Even though the three Eucalyptus species posses many similar diagnostic characters, differences lie in the sizes of (i) the epidermal cells, (ii) stomata and (iii) oil-glands. They also differ in the following physical constants: (i) palisade ratio, (ii) stomatal number, (iii) stomatal index and (iv) vein-islet number.

It was difficult to get any previous work for comparison of results of the Nigerian Eucalyptus species. However, much work has been done on the same species found in Australia.

Fig: 6: Epidermal cells and stomata of E. citriodora

Upper epidermis



Epidermal cell size: 17µ - 19.6µ - 25.5µ

Stomatal size: 17µ - 22µ - 34µ

Lower epidermis



Epidermal cell size: 17µ - 23.8µ - 34µ

Stomatal size: 8.5µ - 16µ - 26µ

Fig. 7: Epidermal cells and stomata of E. camaldulensis

Upper epidermis



Epidermal cells size: 17μ - 19.6μ - 25.5μ

Stomatal size: 8.5μ - 15μ - 17μ

Lower epidermis

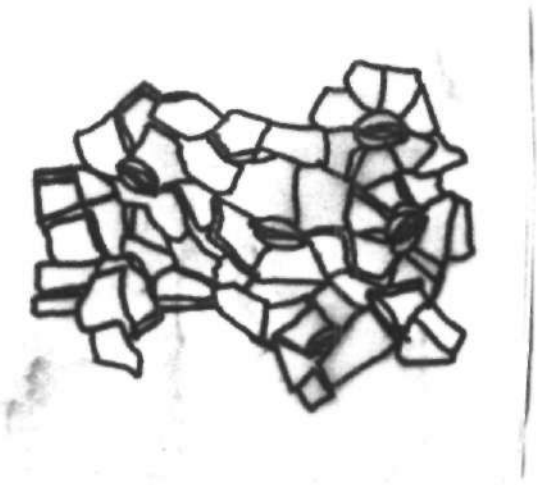


Epidermal cells size: 17μ - 18.7μ - 34μ

Stomatal size: 8.5μ - 15μ - 17μ

Fig: 8: Epidermal cells and stomata of E. tereticornis

Upper epidermis



Epidermal cell size: 17µ - 24µ - 34µ

Stomatal size: 17µ - 26µ - 34µ

Lower epidermis



Epidermal cell size: 17µ - 26µ - 34µ

Stomatal size: 17µ - 22µ - 26µ

Penfold and Willis (1961) described the distribution of stomata in Australian Eucalyptus leaves as being unusual. The arrangement of the stomata on the leaf surfaces is subject to considerable variation. They also noted that the stomatal frequency and the number of stomata per unit area were extremely variable characteristics of the plants. Such variable characteristics were subject to considerable environmental influences also.

Even within the same leaf, the stomatal frequency has been found to vary. Datta and Datta (1952) recorded the frequencies of 85 to 96 stomata per sq. mm on the upper surface of the adult leaves of E. camaldulensis and 185 to 235 per sq. mm for the lower surface.

Our work on the same plant showed the stomatal number per sq. mm to be 45-75-115 and 65-76-95 for the upper and lower epidermises respectively. Results for E. citriodora showed 40-50.5-60 and 45-66-90 for upper and lower epidermises while 35-60.5-85 and 30-46.5-60 per sq. mm for the upper and lower epidermises respectively were obtained for E. tereticornis. Similar work on E. globulus adult leaves by different people produced widely divergent results with regard to sizes of stomata. Wilson (1924) recorded 65u x 55u , Johnson (1926) recorded an average size of 53u x 43u, and Datta and Datta (1952) 28-35u x 23-28u respectively.

Table 1: Comparative Microscopy of the Three Eucalyptus Species

A. QUALITATIVE MICROSCOPY

Characters	Eucalyptus citriodora	Eucalyptus camaldulensis	Eucalyptus tereticornis
1. Calcium oxalate crystals	Prismatic, located on veins, numerous.	Prismatic, some rosettes located on veins, numerous.	Prismatic, located on veins, few rosettes, numerous.
2. Epidermal cells	Have straight anti-clinical walls on both epidermises, thickened.	Have straight anticlinal walls on both epidermises, thickened.	Have straight anticlinal walls on both epidermises, thickened.
3. Oil-glands	Present	Present	Present
4. Stomatal type	Anomocytic	Anomocytic	Anomocytic
	B. QUANTITATIVE MICROSCOPY		
1. Size of epidermal cells			
(a) Upper epidermis	17µ - 19.6µ - 25.5µ	17µ - 19.6µ - 25.5µ	17µ - 24µ - 34µ
(b) Lower epidermis	17µ - 23.8µ - 34µ	17µ - 18.7µ - 34µ	17µ - 26µ - 34µ
2. Size of Stomata			
(a) Upper epidermis	17µ - 22µ - 34µ	8.5µ - 15µ - 17µ	17µ - 26µ - 34µ
(b) Lower epidermis	8.5µ - 16µ - 26µ	8.5µ - 15µ - 17µ	17µ - 23µ - 26µ
3. Size of Oil-glands			
(a) Upper epidermis	63µ - 104µ - 189µ	31.5µ - 126µ - 189µ	63µ - 73µ - 126µ
(b) Lower epidermis	63µ - 110µ - 126µ	31.5µ - 72.5µ - 126µ	63µ - 69µ - 126µ

The size of [illegible] obtained for the upper and lower epi[illegible] triodora was 17µ-22µ-34µ and 8.5µ-16µ-[illegible] E. camaldulensis 8.5µ-15µ-17µ [illegible] the upper and lower epidermises [illegible] 7µ-23µ-26µ respectively was obtained for the upper and lower epidermises of E. tereticornis

Timmermann (1927) however does not recommend the use of stomatal number for differentiating between species that are similar. Rather the ratio of the average stomatal number on upper and lower surfaces of the leaves should be used. The ratios obtained from this work on the local plants were 1.3, 1.0 and 0.8 respectively for E. citriodora, E. camaldulensis and E. tereticornis. This may serve as a means of distinguishing between the species.

Even though information regarding the structure and number of the stomata of Eucalyptus species is generally scanty Penfold and Willis (1961) and Villaca Ferri (1954) figured the number of epidermal cells surrounding the stoma of E. tereticornis to be nine.

However, there is a general agreement that all Eucalyptus species have oil [illegible] which [illegible] an investigation of the oil [illegible] over fifty species, noted the oil-glands [illegible] to be small and evenly distributed to both leaf surfaces in equal numbers. Our work however showed [illegible]

Table 1 (Continued)

C. PHYSICAL CONSTANT VALUE

Characters	Eucalyptus citriodora	Eucalyptus camaldulensis	Eucalyptus tereticornis
1. Palisaide Ratio			
(a) Upper epidermis	3 - 4 - 5	4 - 5 - 7	4 - 5 - 6
(b) Lower epidermis	2 - 3.5 - 4	5 - 6 - 7	2 - 3.5 - 6
2. Stomatal Number			
(a) Upper epidermis	40 - 50.5 - 60	45 - 75 - 115	35 - 60.5 - 85
(b) Lower epidermis	45 - 66 - 90	65 - 76 - 95	30 - 46.5 - 60
Ratio	1.3	1.0	0.8
3. Stomatal Index			
(a) Upper epidermis	7 - 8.6 - 11.8	6.8 - 12 - 15.8	6.6 - 9 - 11.7
(b) Lower epidermis	8 - 10 - 11.9	9.8 - 13 - 18	4 - 6 - 10
4. Vein-Islet Number			
(a) Upper epidermis	5 - 9 - 14	8 - 13 - 17	6 - 11 - 14
(b) Lower epidermis	6 - 9 - 12	8 - 12.5 - 16	10 - 11 - 13

though the oil-glands of the same plant were evenly distributed on both the upper and lower surfaces, the average size of the oil-glands was found to be more than the other two species. Average sizes of the glands were 11u, 10u and 7u respectively for E. citriodora, E. camaldulensis and E. tereticornis.

Environmental factors could account for differences observed in some features of the Eucalyptus species found in Nigeria and other parts of the world such as Australia.

4.4 VOLATILE OIL CONTENTS OF THE THREE EUCALYPTUS SPECIES

The extraction of the volatile oils from the three species was carried out in the months of March (dry season) and May/June (rainy season) to determine the effects of the seasonal changes on the yield of the oils of Eucalyptus citriodora Hook., E. camaldulensis Dehnh. and E. tereticornis Sm. .

The results obtained are summarised in Tables 2 and 3. In the dry season, fresh leaves of E. citriodora yielded more oil than the corresponding dried leaves. The dried leaves of both E. tereticornis and E. camaldulensis had higher oil yields than the fresh leaves. However, the dried leaves of the three species had a higher oil yield than the corresponding fresh leaves during the rainy season. Bellanato and Hidalgo (1971) reported that the formation of Eucalyptus oil is

Table 2: Volatile Oil Contents of the Various Plants

Plant material	Yield (%)
Cymbopogon citratus	0.7
Ocimum gratissimum	0.3
Zingiber officinale	1.3
Eugenia caryophyllata	1.3
Citrus aurantium	0.4
Tangerine	0.5

Table 3: Seasonal Variation in Volatile Oil-Contents of the Three Eucalyptus Species

Plant Materials	Yield (%)			
	Dry Season		Rainy Season	
	Fresh leaves	Dry leaves	Fresh leaves	Dry leaves
Eucalyptus citriodora	2.9	2.0	1.9	3.0
Eucalyptus tereticornis	0.9	1.5	0.2	1.8
Eucalyptus camaldulensis	0.4	1.0	0.35	1.2

highest during the period of maximum growth in spring and summer (March to August). Dzhanashiya and Fogel (1972) also found that the essential oil yields, depending on the season, were due to weather conditions. They represent biological characteristics of the tree variety and an increased content of oils during the flowering stage, i.e., during the rainy season. It was expected that the fresh leaves of the species would yield more oil but this was not the case with our samples. British Pharmacopoeia (1980) recommends that Eucalyptus oil be subjected to rectification (re-distillation) after steam-distillation. A more accurate result may be obtained after the rectification. The resulting oil is lighter in colour, the colouring matter being left as residue in the still. In our experiment, the results and comparisons are expressed on the basis of the dry and fresh weight of leaves. The moisture content of the dried leaves was not determined. An explanation may be given for the decrease yield in oil of the fresh samples. Variations in the moisture content of the fresh sample may cause a decrease in oil yield when calculated on the basis of the weight of the fresh leaves. It may therefore be important to determine the moisture content of the different samples. However, Penfold and Willis (1961) recommend that all oil yields be calculated on dry-weight basis. Other factors which may be of important consideration in future work when comparing the percentage yield of the different samples are:

i. Type and age of leaf: All the Eucalyptus possess both juvenile and adult leaves. Apart from the striking morphological differences, there is a possibility that differences in oil yield may occur due to these factors. It is therefore important to randomize samples by taking leaves from all parts of the tree exhibiting the age groups mentioned above so as to minimise any possible position effect. As the branchlets and petioles yield only a negligible amount of essential oil compared to the leaves, it is important also to standardize samples as consisting of leaf blades only (Penfold and Willis, 1961).

ii. Storage of samples: After taking a sample, the problem of changes occurring in oil content or composition, between removal from the tree and distillation, must be considered. Hence considerations should be given to samples that are obtained far away from the laboratory where the distillation process would be carried out. The maximum 'Safe' storage period must be determined for each species and physiological form of the species.

'Sweating' which occurs if the leaves are tightly packed, results in drastic changes in oil yield and composition (Penfold and Willis, 1961). Leaves therefore should be spread loosely to prevent 'sweating'. Partial drying and withering at room temperature have been reported to cause loss of citronellal (Bruno et al, 1966). The rate of

evaporation of the volatile oil is increased when the leaves are communicated (Guenther, 1961). It may be important to find out how soon the communited leaves have to be extracted to prevent loss of much oil.

iii. Time of distillation: Most essential oils contain varying amounts of constituents which may make it impossible in practice to carry out a steam-distillation to completion (Penfold and Willis, 1961). A stage is however reached after which further distillation yields only negligible quantities of oil. This stage must be determined for each oil type. Penfold and Willis (1961) found this time to be eleven hours for E. macarthuri.

Apart from the Eucalyptus species, all other plant materials were extracted independent of seasonal changes.

On the whole, the overall yields of all the volatile-oil producing plants that may be important in the cosmetic industry may be said to be encouraging. In cosmetic preparations, only small quantities of oil are required for flavouring or colouring the products.

As evident from our results (see Table 3), fresh leaves of E. citriodora should be used for the volatile oil extraction when the oil is required in the dry season. On the other hand, dry-leaf samples of E. camaldulensis and E. tereticornis should be used for the same season. In the rainy season, dry-leaf samples of all the plants should be used. But British

(1979) recommend that the fresh leaves of Eucalyptus trees should be used for obtaining Eucalyptus oil. Also Bruno et al (1966) noted that the best yield in essence and citronellal content was obtained from the fresh leaves of E. citriodora.

The seasonal changes did not only affect the oil yield but also the physical appearance and odour of the oils. This was most noticable in the case of E. citriodora. The oil obtained from the dry leaf samples of the plant during the rainy and dry seasons were colourless and more 'citron-scented'. In the rainy season, the fresh leaves yielded a colourless oil while the dried leaves yielded a pale-yellow oil which was more 'citron-scented' than the fresh leaves. The fresh leaf oil sample was less 'citron-scented'. However, Bruno et al (1966) obtained the best essence from the fresh leaves of the same plant. The physical properties of the oils were very close to official recommendations.

As presented in Table 3, the total yields of volatile oils of fresh leaves of E. citriodora, E. camaldulensis and E. tereticornis in the dry season were 2.9% (v/w), 0.9% (v/w) and 0.4% (v/w) respectively.

But Akinloye and Adegbehin (1984) reported that they contained 3.4%, 0.6% and 0.8% (v/w) respectively in March (dry season). However, these variations may be due to a number of factors as discussed before. The

yield and quality of the volatile oils of the Eucalyptus species would make them suitable for large scale exploitation and are so recommended.

For cosmetic purposes, the oil of E. citriodora is more important (Penfold and Willis, 1961) while the E. camaldulensis and E. tereticornis are more valuable for industrial and medicinal uses. The uses are based on the high citronellal (65 to 80%) content of the E. citriodora (Penfold and Willis, 1961). The other two Eucalyptus species have a higher cineole content (Penfold and Willis, 1961). The local samples of the E. citriodora were found to have yielded more oil (see page 89) than the other species whether the dried or fresh leaves were used. This higher yield of good quality oil in E. citriodora makes it a potential raw material for commercial production of Eucalyptus oil locally for cosmetic, especially perfumery and food industries. Also, the higher oil yield of this particular species may be due to the fact that its oil glands are larger than those of the other two species (see Table 1).

Apart from the high yield and good quality of the Eucalyptus oil produced from the three species which could make them suitable for large scale exploitation, over 7,000 hectares of Eucalyptus trees are spread through Kaduna, Plateau, Kano, Gongola and Bauchi States of Nigeria (Akinloye and Adegbehin, 1984). The three main species in these plantations have been found to be

E. camaldulensis, E. tereticornis and E. citriodora. At present, only the woody parts of these trees are being utilised mainly in the form of fuel wood and electric poles. The leaves are left in the forest unexploited. In view of the abundance of these trees, the high yield of good quality oil obtained in our work and easy availability, the Eucalyptus trees should be locally exploited for the various uses that have been outlined.

4.5 CHEMICAL CONSTITUENTS OF THE VOLATILE OILS OF THE VARIOUS PLANTS

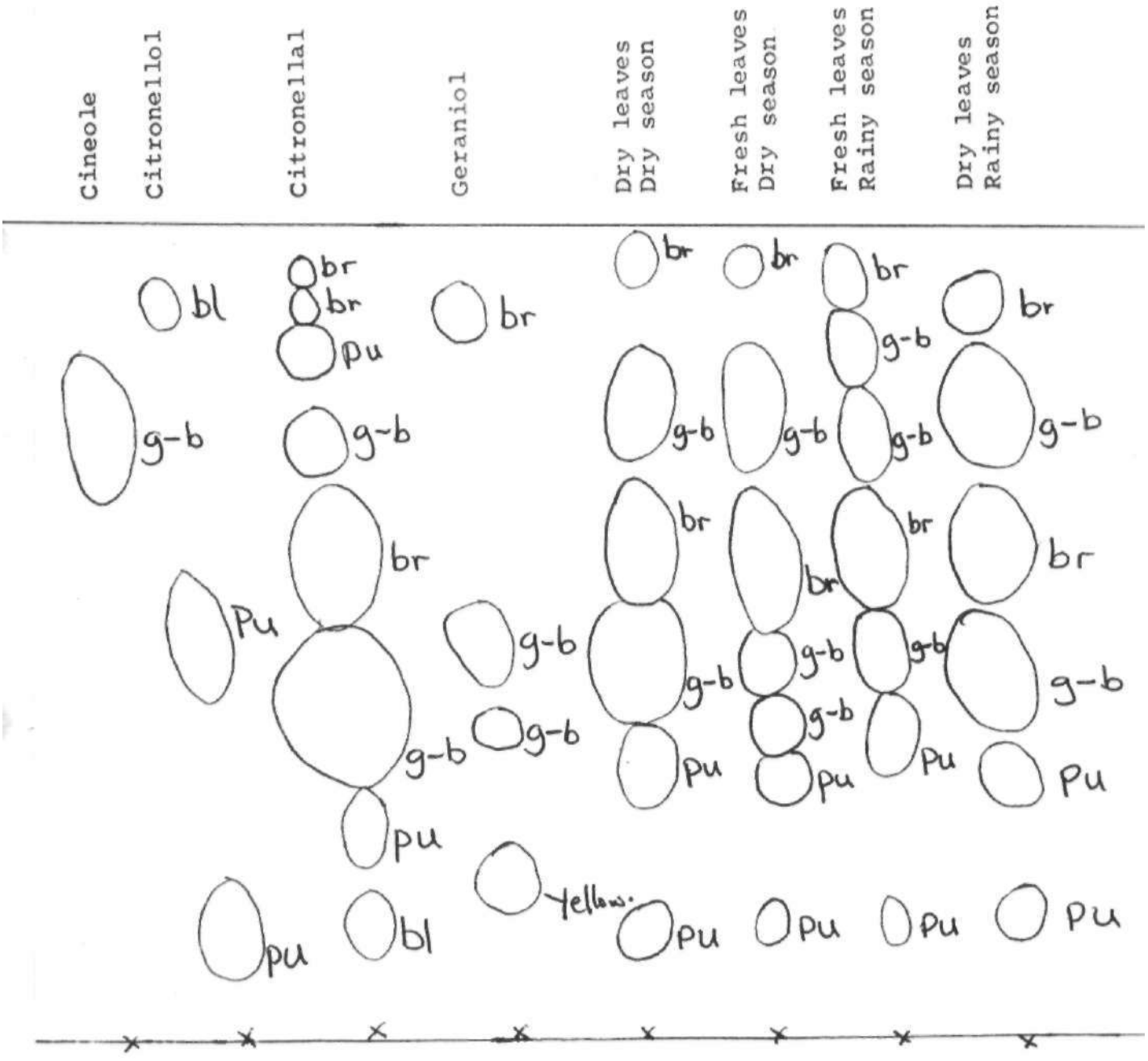
1. Thin-Layer Chromatographic Examination

Chromatographic separation of the volatile oils extracted from the three Eucalyptus species and the other volatile oil-containing plants was carried out to identify their various constituents. The best solvent system which could give the best separation of the individual components was also determined. Identification of the spots were ascertained by co-chromatography with authentic samples and by the chromogenic reactions of the constituents with the spray agents. Results have been summarised in Tables 4 and 5.

The constituents of the oil of Eucalyptus citriodora were identified by TLC as citronellol, citronellal, geraniol and cineole (see fig. 9). An apparently unknown constituent was found to be present in all the samples of this oil. Citronellal appeared to be the major constituent of this oil as it always gave the biggest spot in all the samples and this was more in the dry leaf samples in both the dry and rainy seasons.

Penfold and Willis (1961) in their study of Eucalyptus citriodora reported the following as the principal constituents: citronellal (65-80%), citronellol

Fig. 9: Thinlayer chromatographic separation of *E. citriodora* oil.



Key:

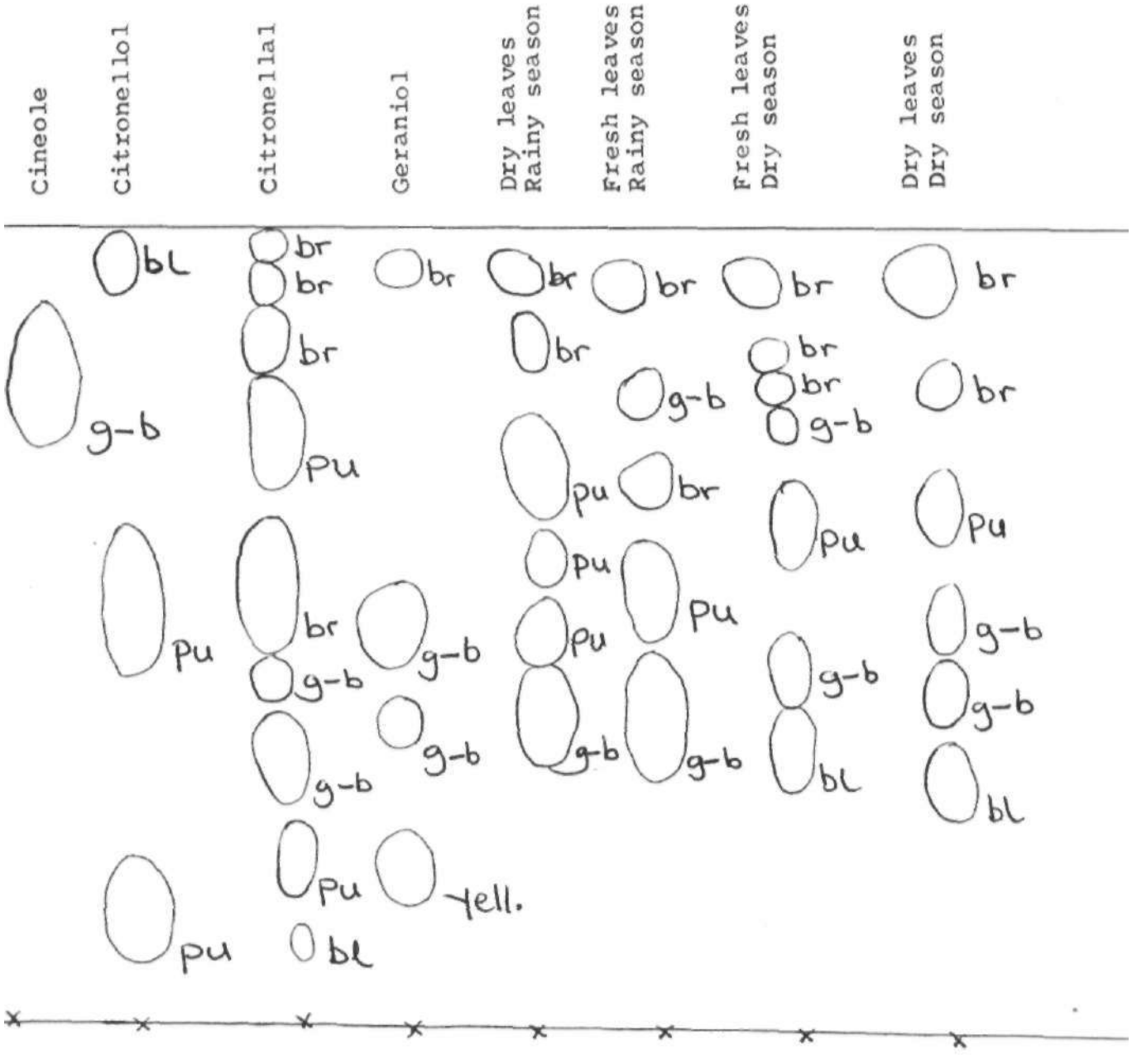
bl	=	blue
g-b	=	greenish brown
pu	=	purple
br	=	brown

(15-20%) and esters. Akinloye and Adegbehin (1984) also recorded the principal constituents of E. citriodora as citronellal, citronellol and cineole. Identification of citronellal, citronellol and cineole in E. citriodora by this investigation therefore agrees with the report of Penfold and Willis and also that of Akinloye and Adegbehin.

Bruno et al (1966) in a similar study of this plant reported the constituents to be citronellal, citronellol, cineole, geraniol, phellandrene and two unidentified spots. On this basis also results obtained in this investigation agree with those reported in the literature.

Eucalyptus camaldulensis has been reported to contain p-cymene, phellandrene, cuminal, phellandral, geraniol and cineole (8-10%) (Penfold and Willis, 1961). Spots obtained in this investigation were identified to be citronellol, citronellal, geraniol, cineole and an unknown (see fig. 10). Cineole and geraniol were absent in the oil samples extracted from the dry leaves in the rainy season. Geraniol was absent in the fresh leaves in the rainy season. Also, cineole was present in the fresh leaves in the dry season but absent in the dry leaves. Both geraniol and cineole were only identified in the fresh leaves in the dry season. The unknown constituent was not present in the oil of the fresh and dry leaves in the rainy season. The identification of

Fig. 10: Thinlayer chromatographic separation of E. camaldulensis oil.

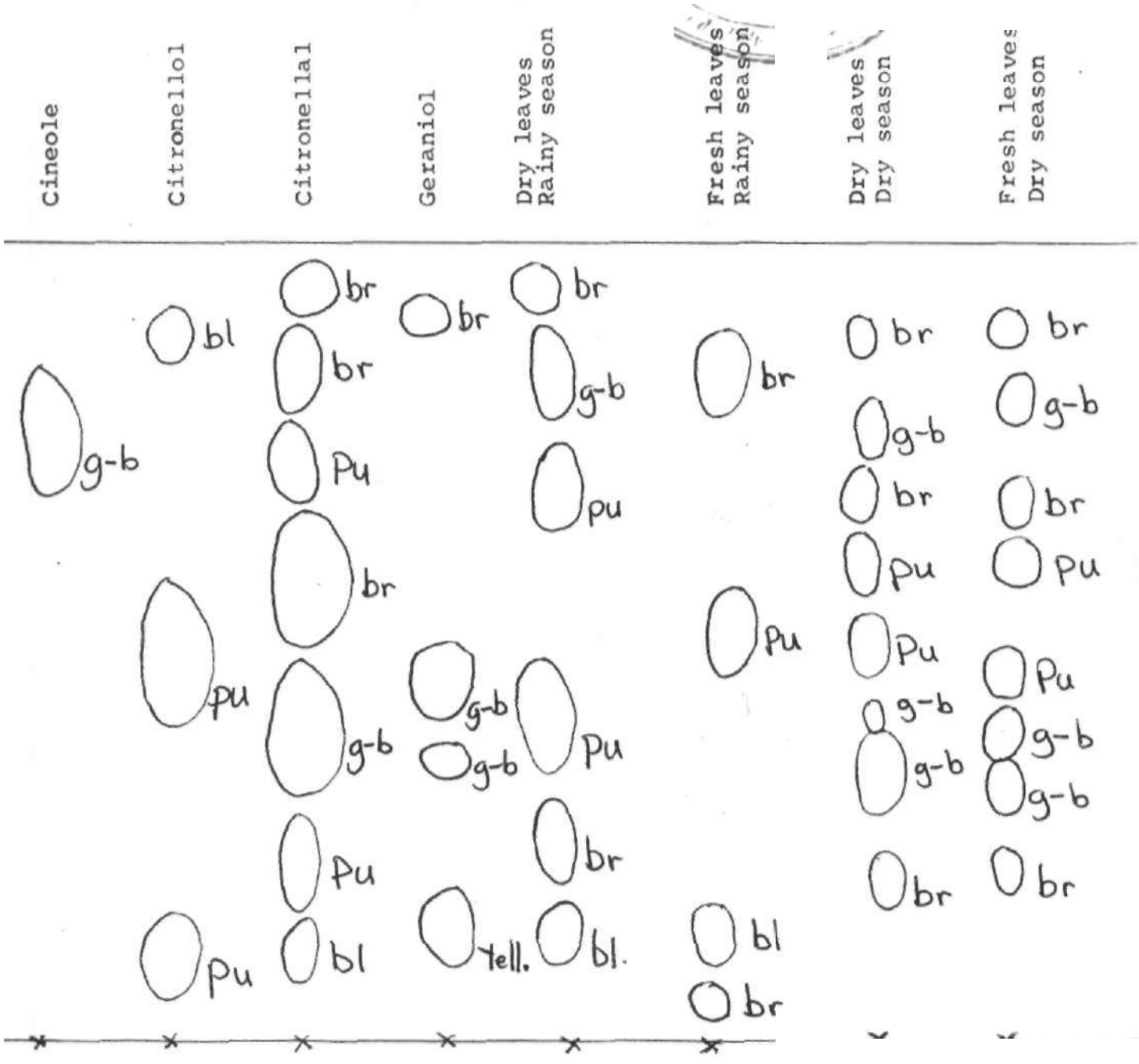


the above mentioned constituents agrees more with that of Akinloye and Adegbehin (1984) who also reported the identification of phellandrene, citronellol, citronellal, cineole and an unknown, than that of Penfold and Willis (1961).

Eucalyptus tereticornis has been reported to contain p-cymene, cuminal, phellandral, pinene and cineole as the principal constituents (Penfold and Willis, 1961). Akinloye and Adegbehin (1984) identified the constituents of the Nigerian plant as phellandrene, citronellol, cineole, citronellal and an unknown. In this analysis, the E. tereticornis oil was found to contain citronellol, citronellal, cineole and an unknown (see fig. 11). The identification of these constituents also agree with the results in the literature. Cineole was present in all the oil samples except that extracted from the fresh leaves in the rainy season.

As was observed, seasonal changes not only affected the oil yield but also the constituents. Thus, while geraniol was present in the oil extracted from the fresh leaf samples of E. citriodora in the dry and rainy seasons, it was absent in all other samples. Also, cineole was absent in the oil samples extracted from the dry leaves of E. camaldulensis in both dry and rainy seasons. Geraniol was present only in the oil of the dry and fresh leaves of this plant in the dry season.

Fig. 11: Thinlayer chromatographic separation of E. tereticornis oil.



In E. tereticornis, cineole was absent only in the oil of the fresh leaves in the rainy season. It was however present in all the other samples.

Citronellal was observed to be more in quantity than the other constituents in the E. citriodora oil extracted from the dry leaves. This may account for the strong odour perceived in this sample (see page 93).

Constituents of the other oils, namely lemongrass, orange peel, clove, ocimum and ginger oil have been summarised in Table 6.

Poucher (1974) reported the principal constituents of lemongrass oil as citral (80%), citronellal, geraniol, linalol and esters. Results obtained in this investigation showed the constituents as citral, geraniol, citronellal and an unknown.

Citronellal, limonene, citral and an unknown were identified as the constituents of oil of orange peel. Poucher (1974) also reported the constituents of this oil to be citral, linalol, limonene, citronellal and esters.

Eugenol, vanillin and an unknown were identified as the constituents of clove oil. Wallis (1967) also gave the list of some of the constituents of this oil to be as above.

Ginger oil also was found to contain citral, borneol and six unknown spots. The presence of citral

ble 4: Thin-layer chromatography of the volatile oils of the three Eucalyptus species

Reference Samples	E. citriodora				E. camadulensis				E. tereticornis			
	Dry Season		Rainy Season		Dry Season		Rainy Season		Dry Season		Rainy Seas	
	Fresh leaves	Dry leaves	Fresh leaves	Dry leaves	Fresh leaves	Dry leaves	Fresh leaves	Dry leaves	Fresh leaves	Dry leaves	Fresh leaves	Dry leave
Citronellol	1(0.12)	1(0.12)	1(0.12)	1(0.12)	1(0.64)	1(0.65)	1(0.54)	2(0.5, 0.54)	2(0.50, 0.65)	2(0.65, 0.50)	1(0.54)	1(0.4
Citronellal	3(0.5, 0.42, 0.92)	3(0.42, 0.58, 0.92)	3(0.58, 0.81, 0.54)	3(0.42, 0.85, 0.54)	3(0.50, 0.85, 0.81)	3(0.42, 0.50, 0.92)	3(0.69, 0.73, 0.42)	4(0.42, 0.92, 0.73, 0.42)	4(0.42, 0.58, 0.69, 0.96)	4(0.42, 0.69, 0.58, 0.96)	2(0.23, 0.92)	3(0.9 0.5 0.2
Cineole	1(0.77)	1(0.77)	1(0.77)	1(0.77)	1(0.77)	-	1(0.77)	-	1(0.77)	1(0.77)	-	1(0.7
Geraniol	1(0.54)	-	1(0.46)	-	1(0.92)	1(0.64)	-	-	-	-	-	-
Unknown	1(0.31)	1(0.31)	1(0.31)	1(0.31)	1(0.35)	1(0.35)	-	-	1(0.31)	1(0.31)	1(0.11)	1(0.3
Total Number of Spots	7	6	7	6	7	6	5	6	8	8	4	6

Note: R_f values in parenthesis

and borneol in ginger oil agrees with the report of Wallis (1967).

Geraniol, cineole, camphene, limonene and an unknown constituent were identified in ocimum oil. Guenther (1964) gave some of the constituents of ocimum oil as limonene, geraniol, camphene, myrcene, carvone, linalol, thymol, pulegone, cineole and caryophyllene.

The inability to identify some of the constituents of the various oils, named as unknown, was mainly due to lack of proper reference samples. Thus some of these unknown spots may well be the ones reported by others.

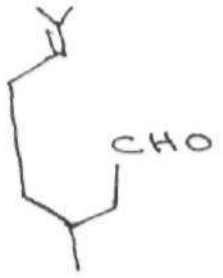
Results obtained by this investigation showed the best solvent system for the separation of the Eucalyptus oils to be benzene : ethylacetate (95:5). Silica gel GF 254 plate was found to be the best adsorbent layer.

It was necessary to carry out the chromatographic separation of the oils to determine their individual constituents. For cosmetic purposes in general, only one or sometimes more of the oil constituents may be required for use. For example, in perfumery and flavouring, only the citronellal constituent of E. citriodora is useful (Penfold and Willis, 1961).

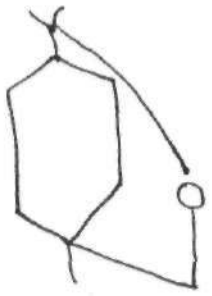
Table 5: Thin-layer chromatography of the volatile oils of the other plants

Oils	Constituents	R_f values
Lemon grass	1. Citral	0.5
	2. Geraniol	0.43
	3. Citronellal	0.28
	4. Unknown	0.17
Orange peel	1. Citronellal	0.1
	2. Limonene	0.57
	3. Citral	0.5
	4. Unknown	0.17
Clove	1. Eugenol	0.5, 0.14
	2. Vanillin	0.29
	3. Unknown	0.36
Ocimum	1. Geraniol	0.43
	2. Cineole	0.8
	3. Limonene	0.57
	4. Camphene	0.73
	5. Unknown	0.17
Ginger	1. Citral	0.58, 0.46
	2. Borneol	0.36
	3. Unknowns	0.96,0.85, 0.77 0.69, 0.24,0.17

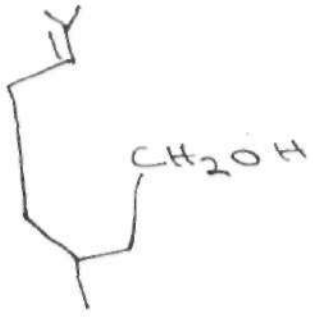
Structures of some of the volatile oil constituents



Citronellal



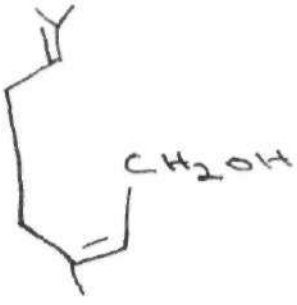
1,8-Cineole,



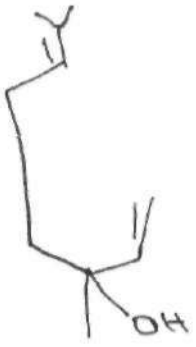
Citronellol



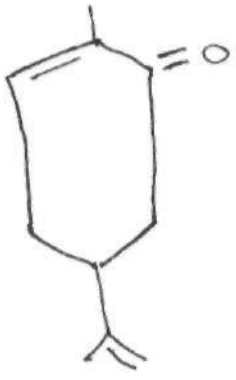
Ocimene



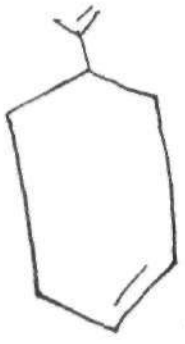
Geraniol



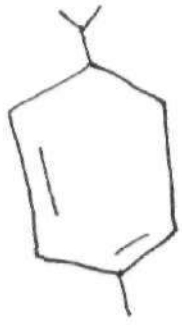
Linalool



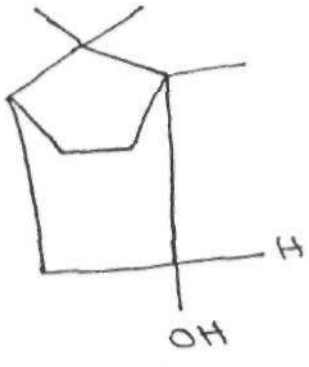
Carvone



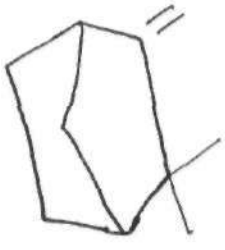
Limonene



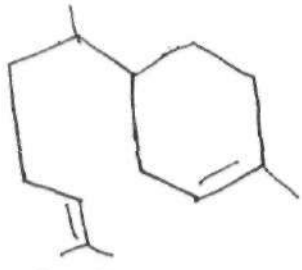
Phellandrene



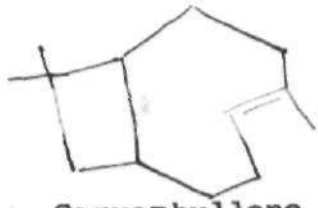
Borneol



Camphene



Zingiberene



Caryophyllene

2. Gas-Liquid Chromatographic Examination

For convenience, Gas-liquid Chromatographic examination was confined to the three Eucalyptus oils only.

Identification of the constituents was by peak height measurement and in some cases by the retention time. Results of the GLC obtained showed the major constituents of A_1, oil from Eucalyptus citriodora extracted from the fresh leaves in rainy season, to be citronellal and citronellol (see fig. 12). Penfold and Willis (1961) in their study of E. citriodora also established the main constituents of the plant to be citronellal (65 to 80 percent), citronellol (15 to 20 percent) and esters. The cineole content in this oil is low. Also, Akinloye and Adegbehin (1984) determined by gas chromatographic analysis the major constituent of E. citriodora extracted in March (dry season) to be citronellal, citronellol and cineole in the ratio of 45:4:1. Infra-red analysis by Bellanato and Hidalgo (1971) showed citronellal as the major component of E. citriodora oil.

The same components mentioned above were identified in A_2, A_3 and A_4 representing E. citriodora oil extracted in the rainy season from the dry leaves, oil extracted from the fresh leaves in the dry season and that from the dry leaves in the dry season respectively (see figs. 13 to 15)

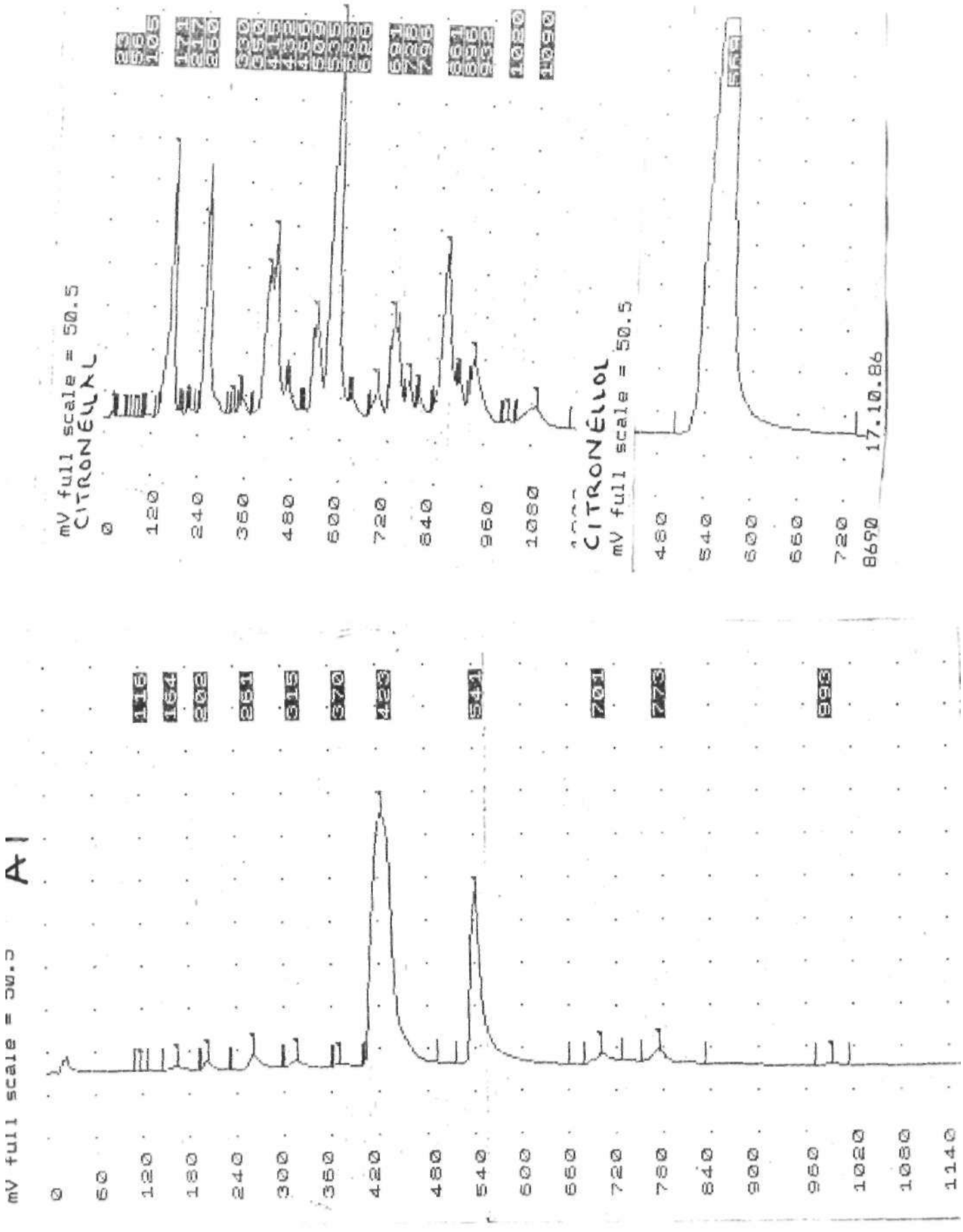


Fig. 12: Gas liquid chromatogram of E. citriodora oil (Fresh leaves, Rainy Season)

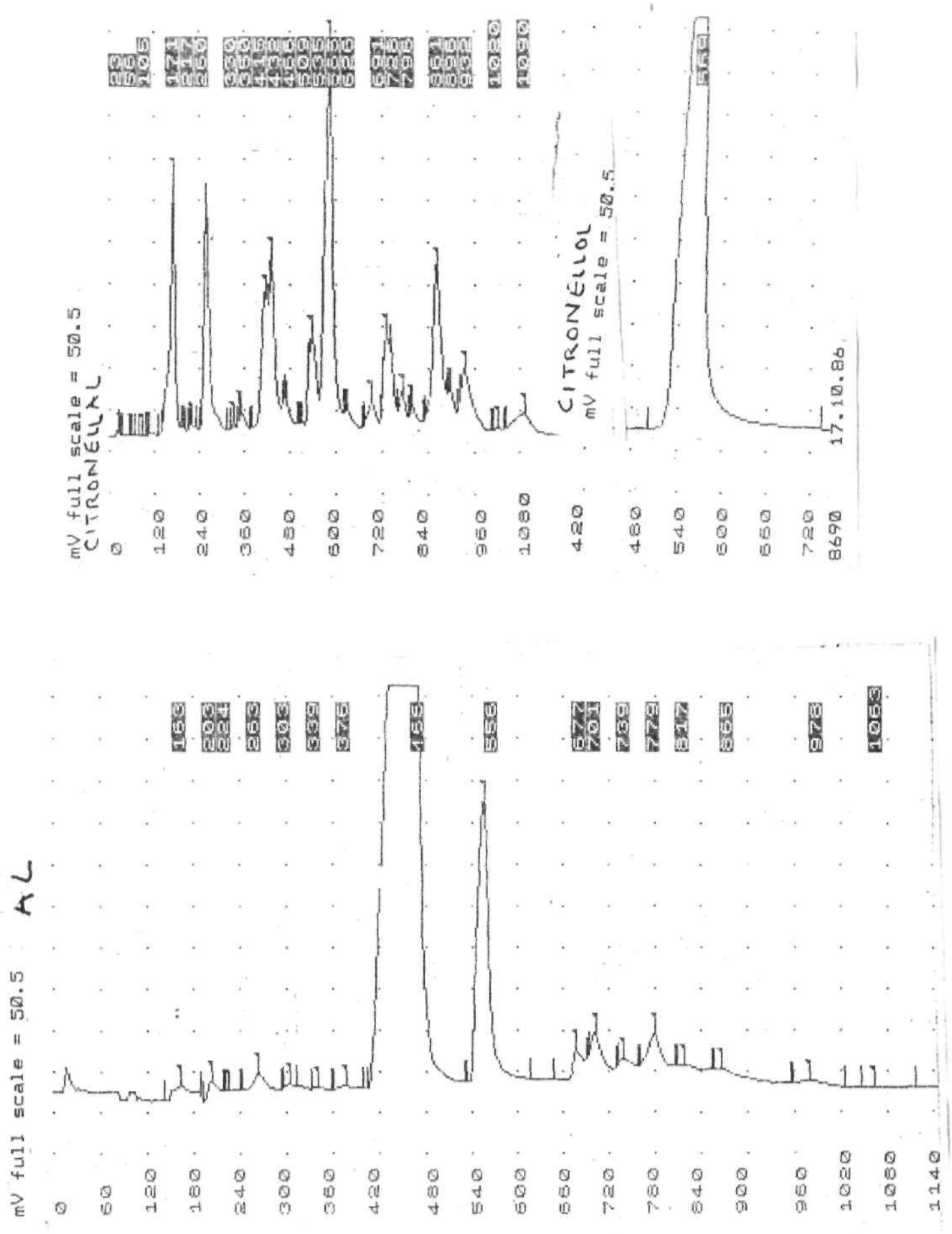
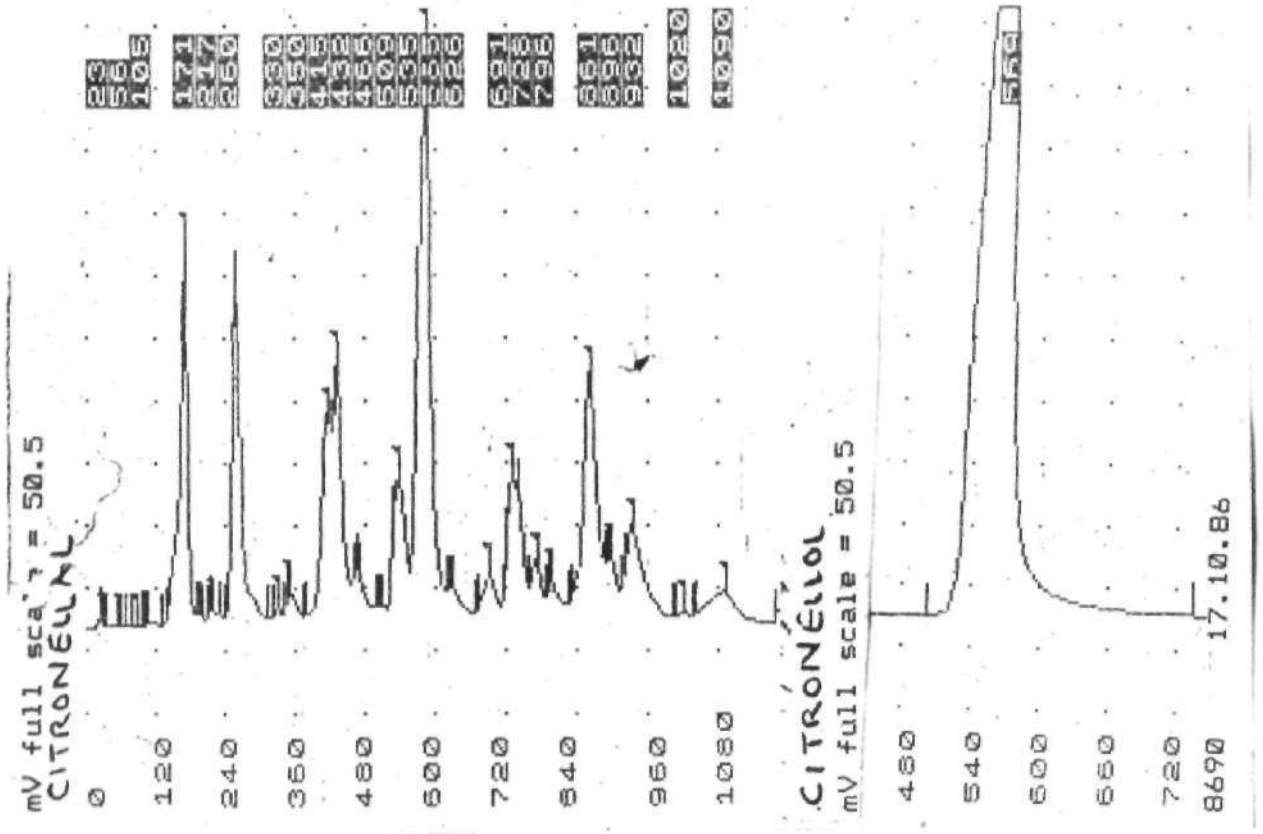


Fig. 13: Gas liquid chromatogram of E. citriodora oil.



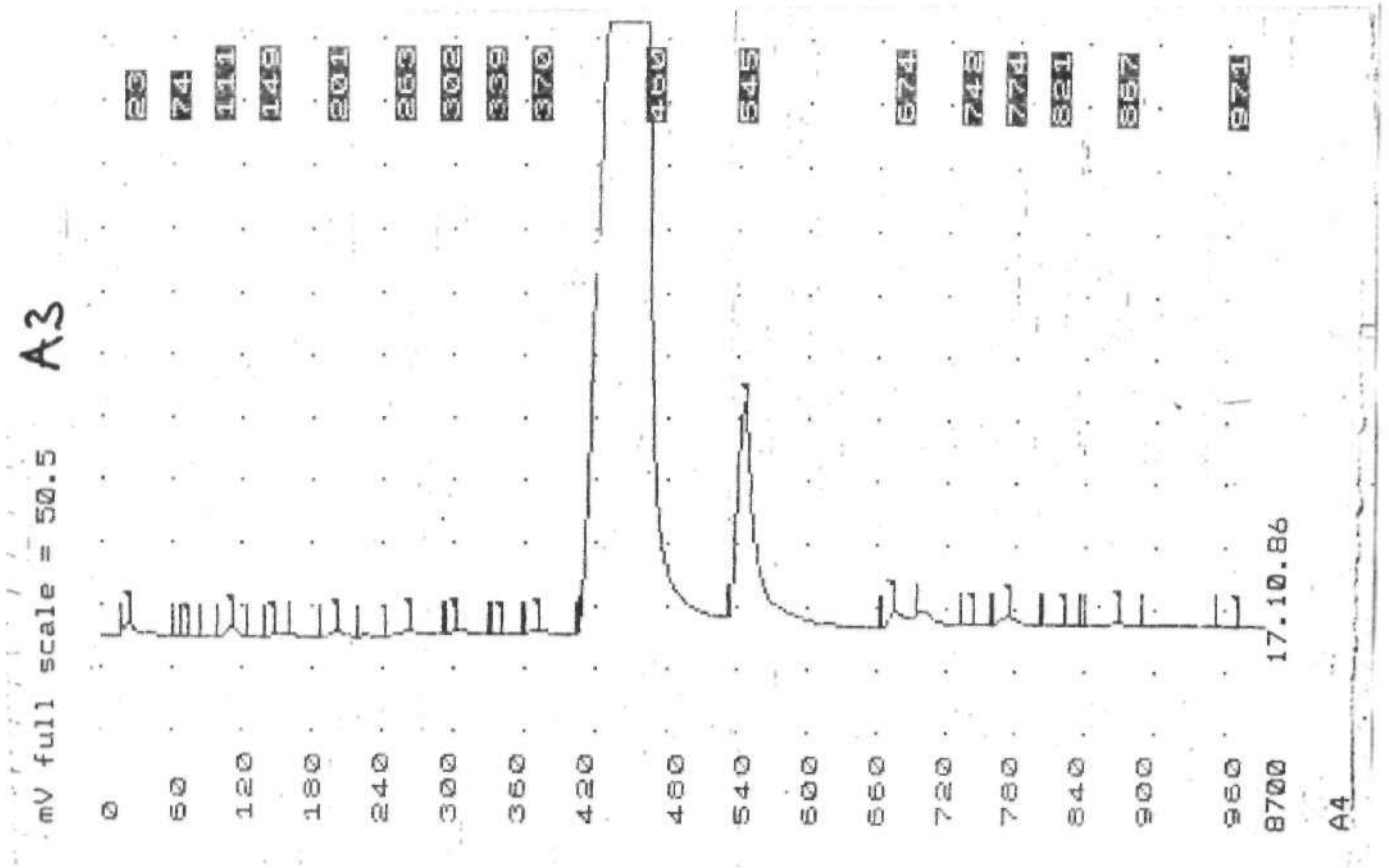


Fig. 14: Gas liquid chromatogra[illegible] of E. citriodora oil.
(Fresh leaves, Dry season)

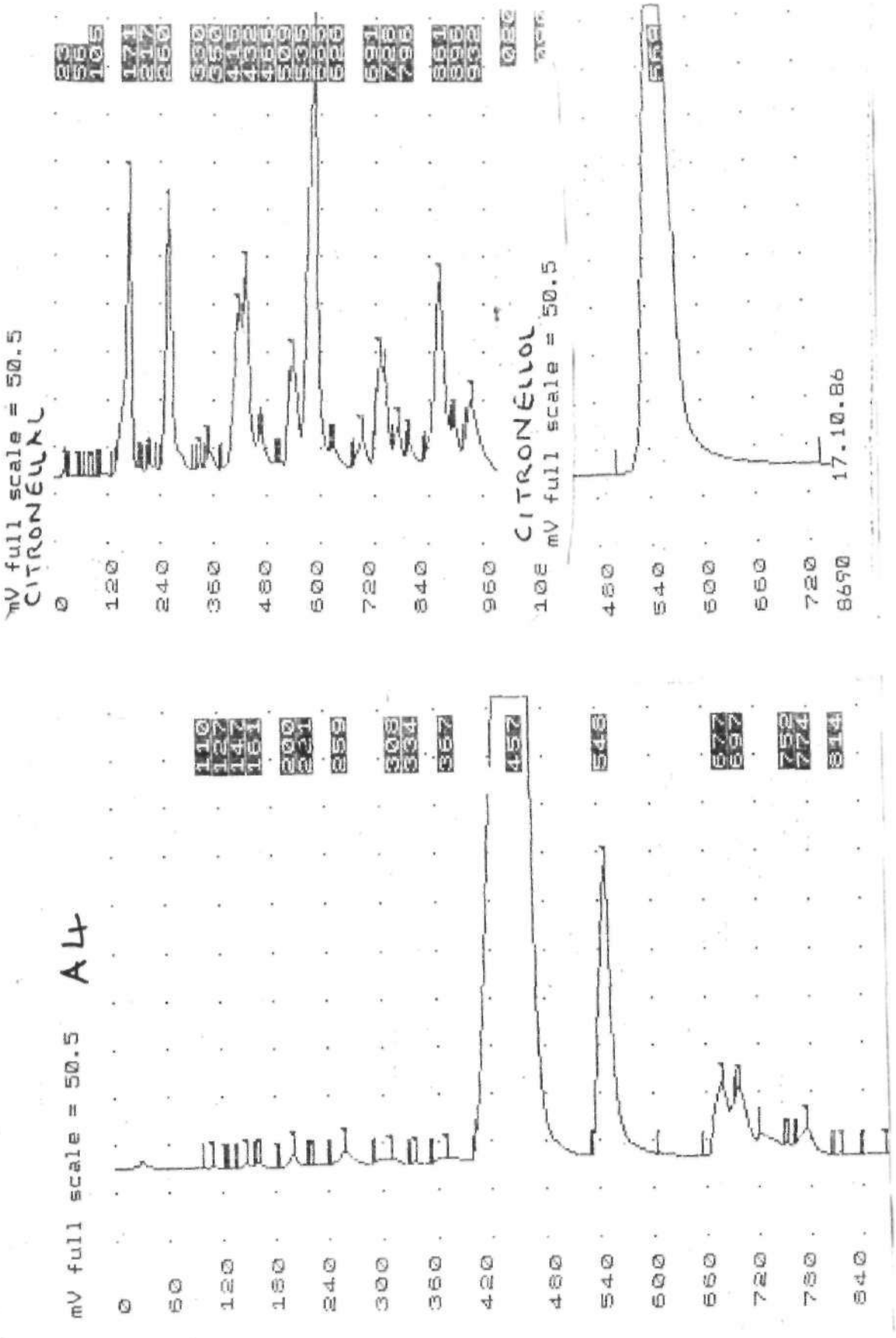


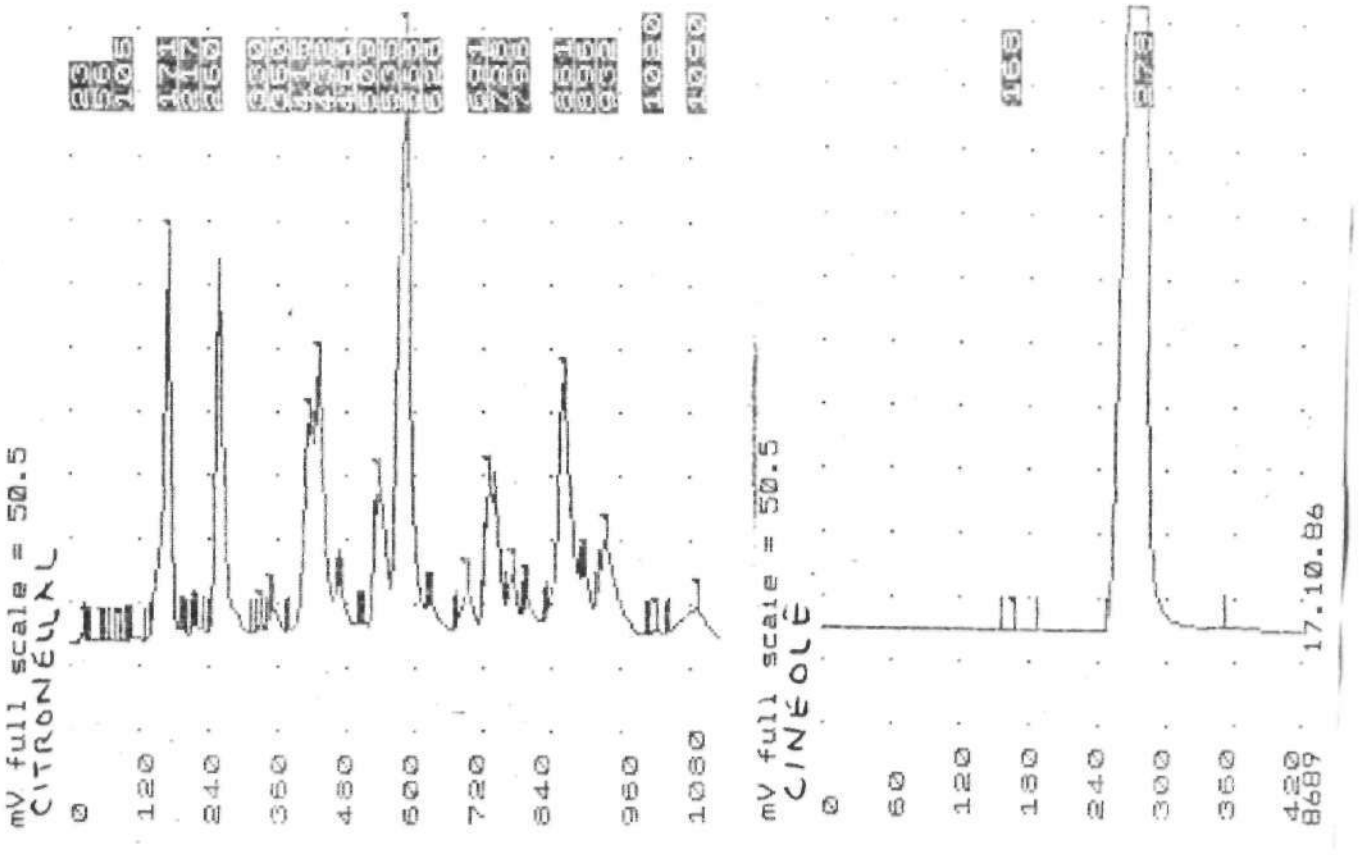
Fig. [illegible] Gas liquid chromatogram of E. citriodora o
(Dry leaves, Dry season)

However, the peaks obtained showed the presence of the constituents in different proportions. This was dependent on the season. The quantity of the citronellal was more in A_2, A_3 and A_4 than in A_1 and the amount in the first three oil samples was approximately the same.

The citronellol on the other hand was present in a higher quantity in A_2 and A_4, but the proportion was observed to be highest in A_2. Thus, the quantity of citronellal is more in the dry season whether the fresh or dry samples were used or in the rainy season when the dry sample is used.

The oils extracted from the fresh leaves of E. tereticornis in the rainy season (B_1), dry leaves in rainy season (B_2), fresh leaves in dry season (B_3) and dry leaves in the dry season (B_4), all contained a large proportion of cineole, citronellal which appeared at two different peaks and two unknown components. These could not be identified due to lack of authentic samples. One of the unknowns was present in about the same quantity as the cineole (see figs. 16 to 19).

The cineole proportion was reduced in B_3, but there was an increase in one of the peaks for citronellal. In B_4, six main components were chromatographed. Two of them were identified as cineole and citronellal, while the others could not be positively identified.



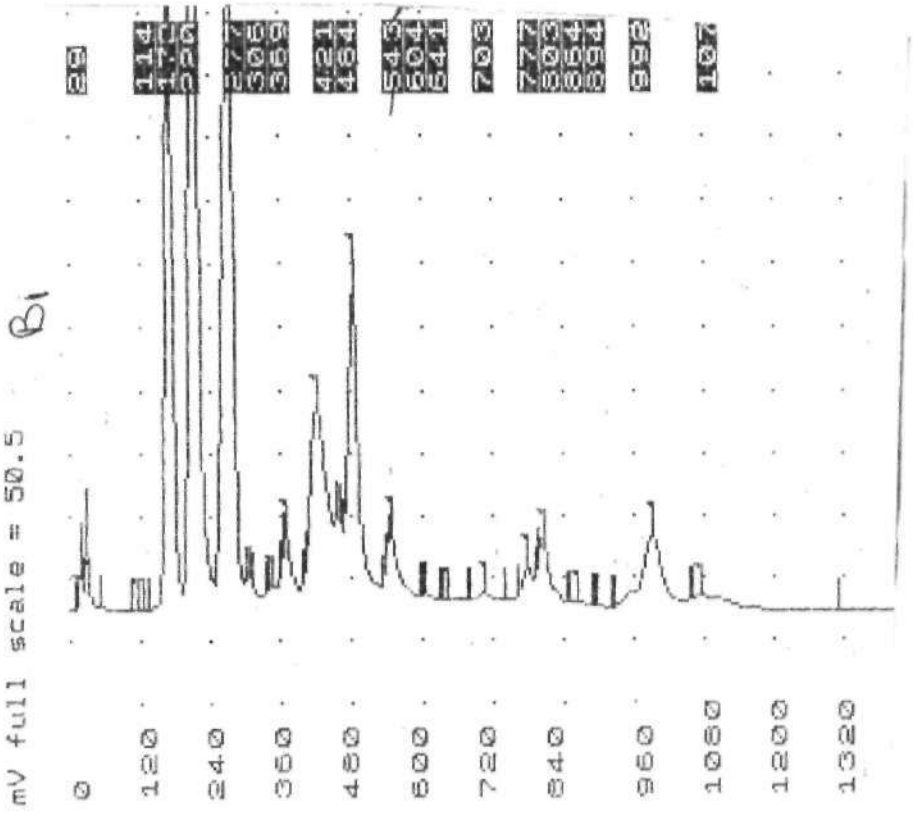
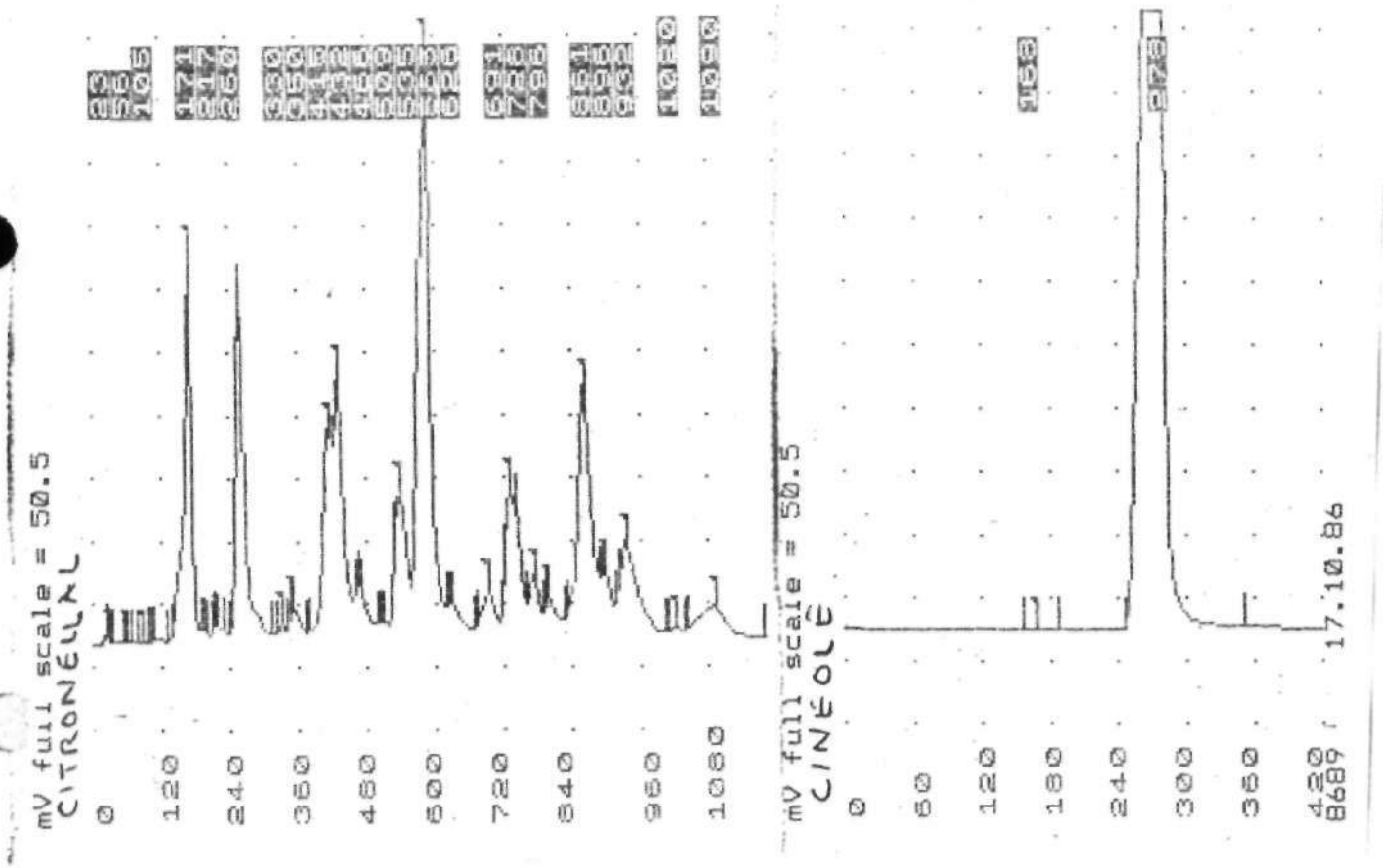


Fig. 16: Gas liquid chromatogram of E. tereticornis oil (fresh leaves, Rainy sea



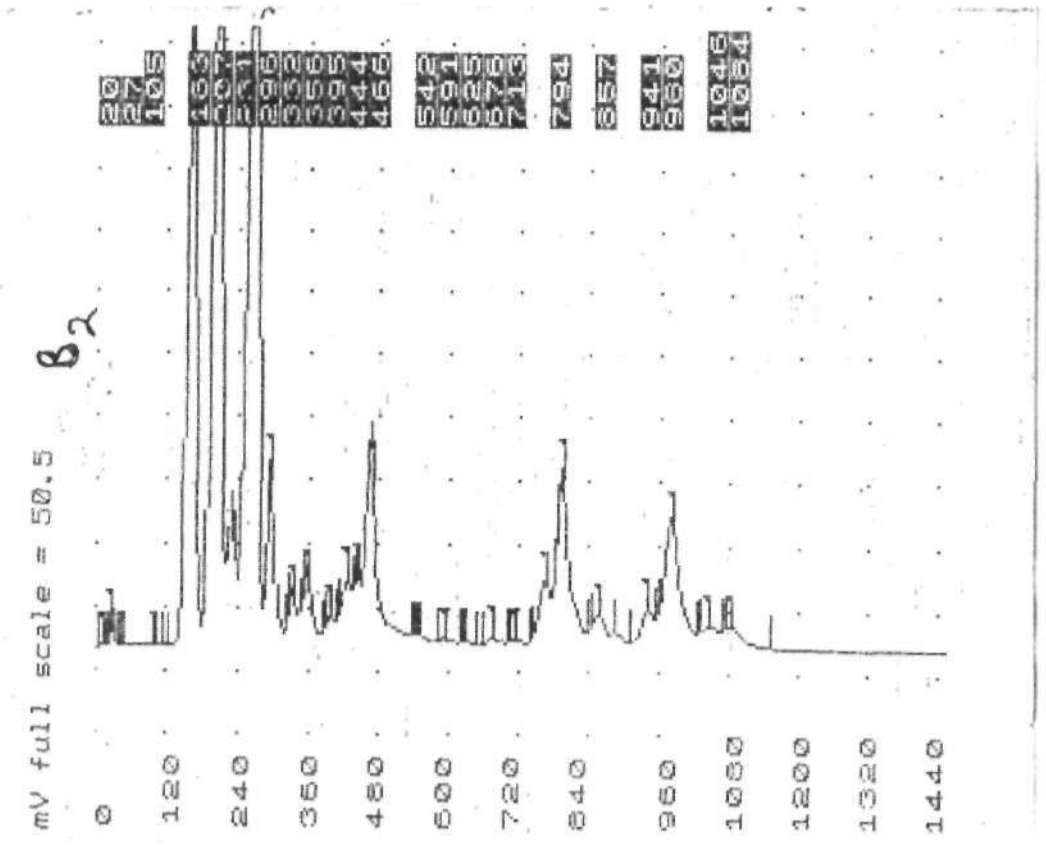
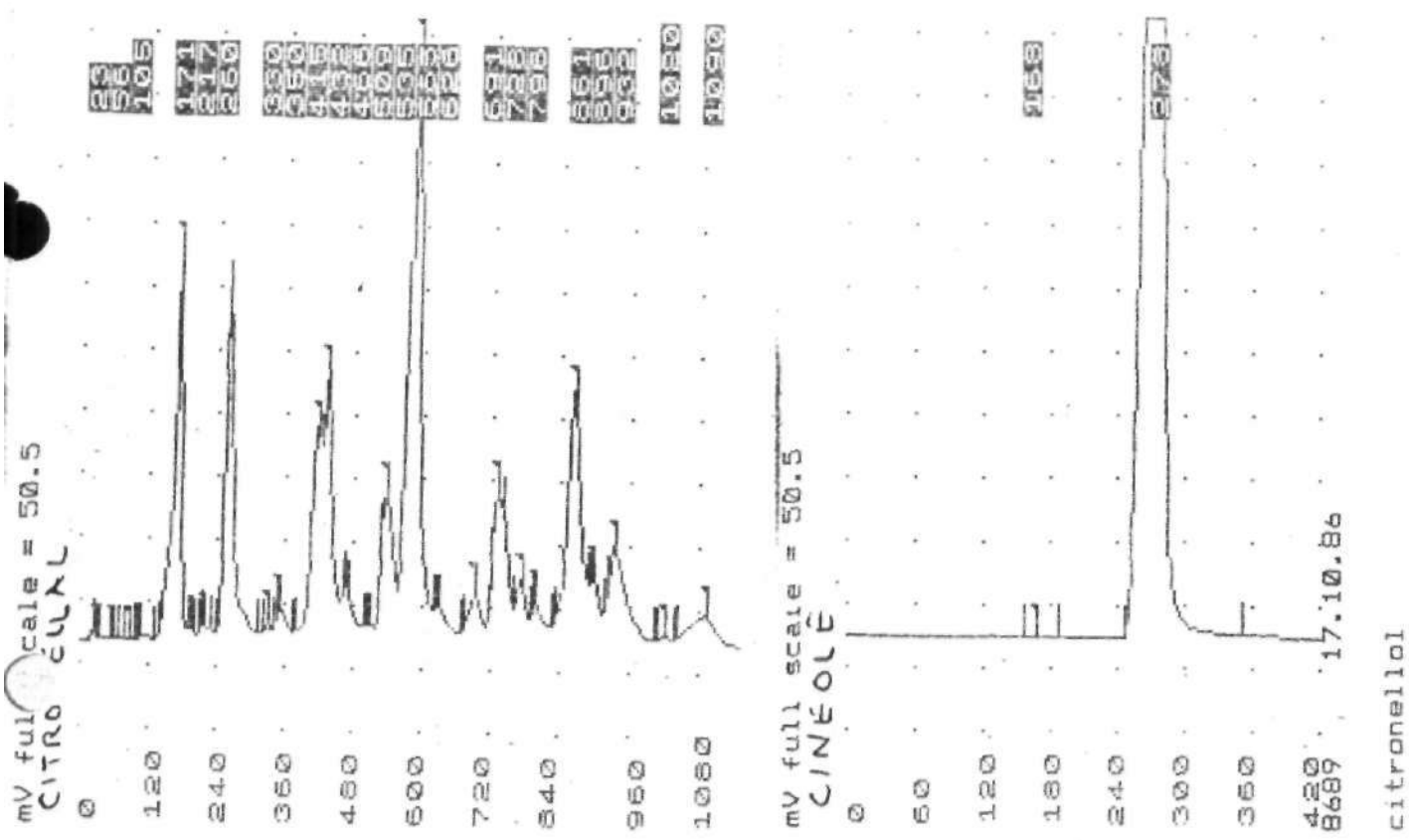


Fig. 17: Gas liquid chromatogram of E. tereticornis oil (Dry leaves, Rainy season)



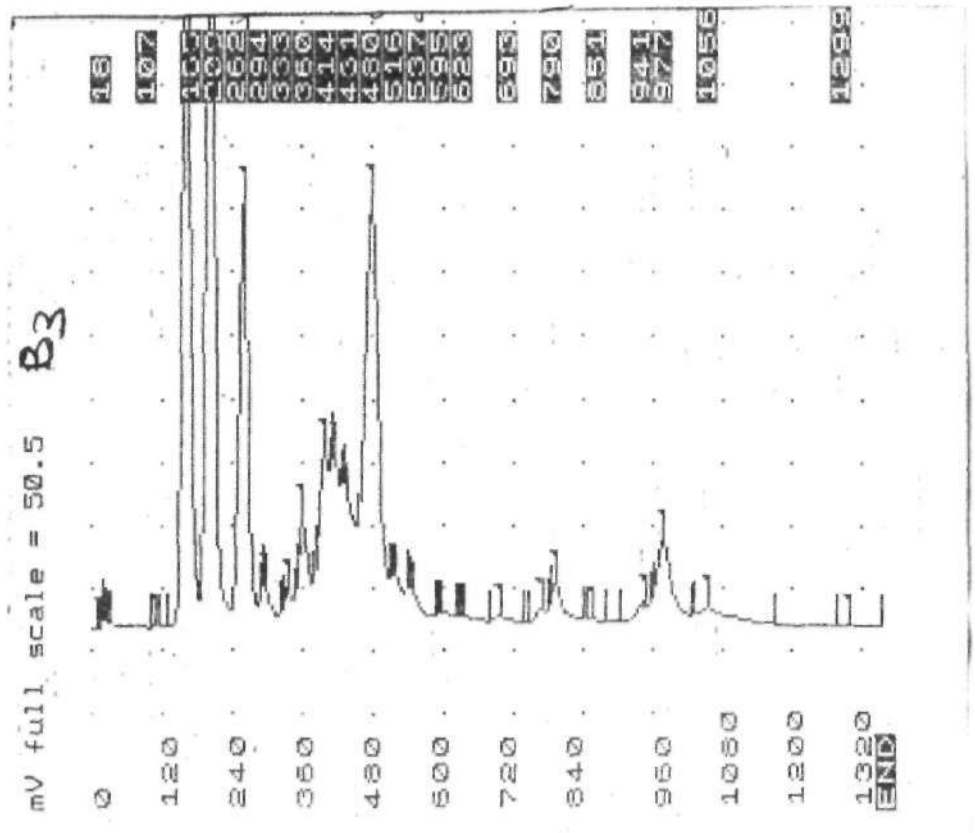
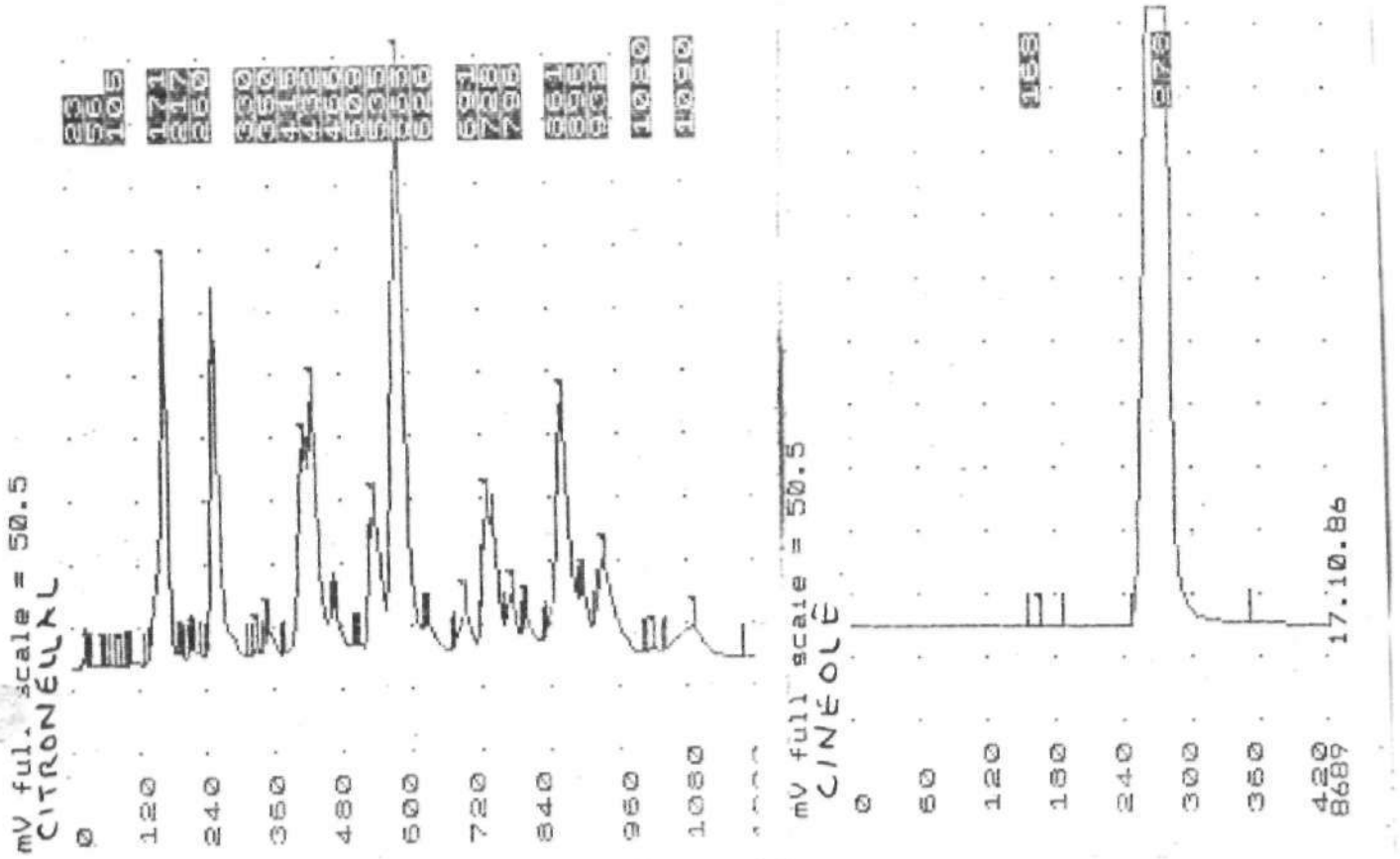


Fig. 18: Gas liquid chromatogram of E. tereticornis oil (Fresh leaves, Dry se[illegible])



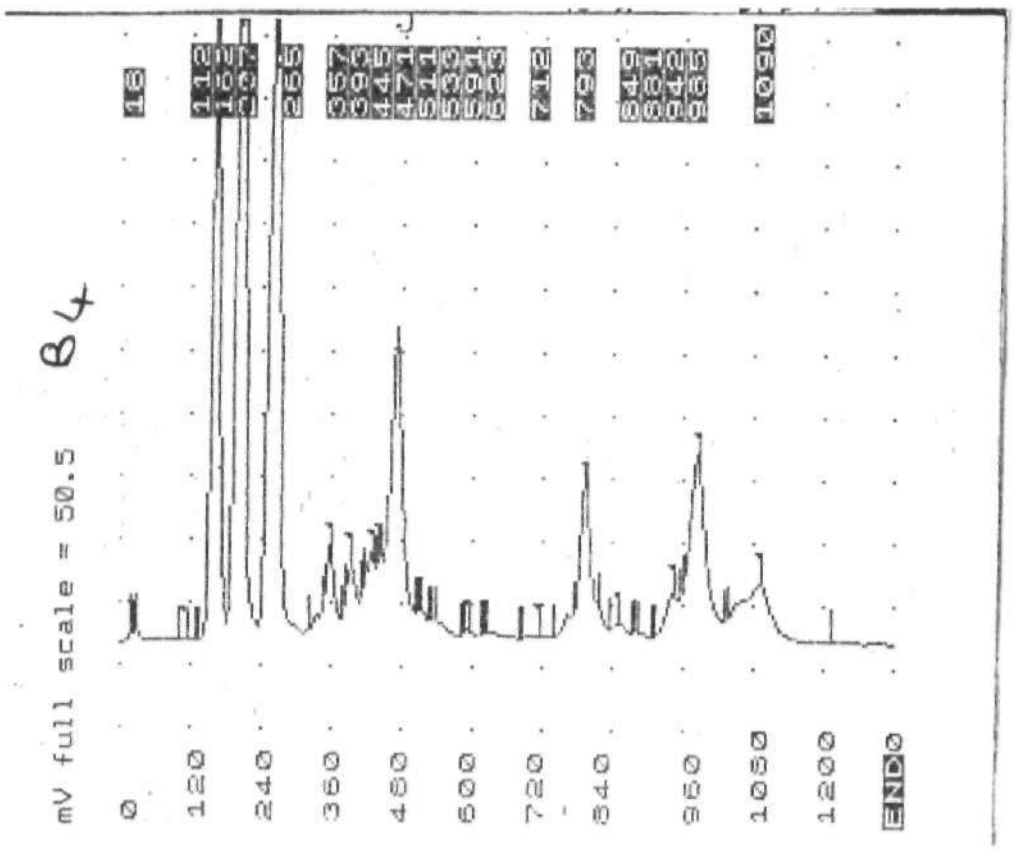


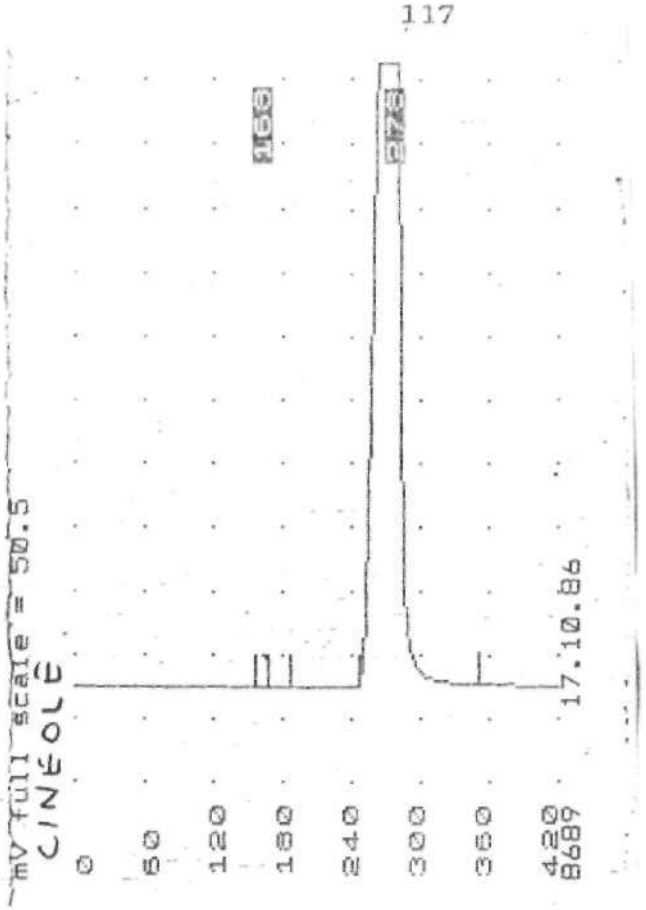
Fig. 19: ...s liquid chromatogra... of E. tereticornis oil.
(Dry leaves, Dry season)

C_1, C_2 and C_3 represent E. camaldulensis oil extracted from the fresh leaves in the dry season, dry leaves in the rainy season and the dry leaves in the dry season respectively. Cineole was found to be the main constituent in samples C_1 to C_3. An unknown component with the same peak height as the cineole was observed in C_3 (see figs.20 to 22).

The cineole is present in all the samples in approximately the same quantity. Penfold and Willis (1961) also identified the main constituents of this plant to be cineole (8 to 10 percent), geraniol, phellandrene, cuminal, p-cymene and phellandral. Akinloye and Adegbehin (1984) also gave the ratio of the cineole, citronellol and citronellal in E. camaldulensis to be 15:2:1.

Thus the results obtained here showed citronellal to be the main constituent of E. citriodora. Its proportion is highest in the dry and fresh leaves in the dry season and the dry leaves in the rainy season. Its proportion was lowest in the oil from the fresh leaves in the rainy season.

It may be recommended then that the dried leaves of E. citriodora be used when the oil is required for cosmetics in either rainy or dry season. The fresh leaves in the dry season may also be used. This is due to the fact that citronellal, which is the component in E. citriodora that makes it valuable in cosmetics (Penfold and Willis, 1961), is in a higher proportion then.



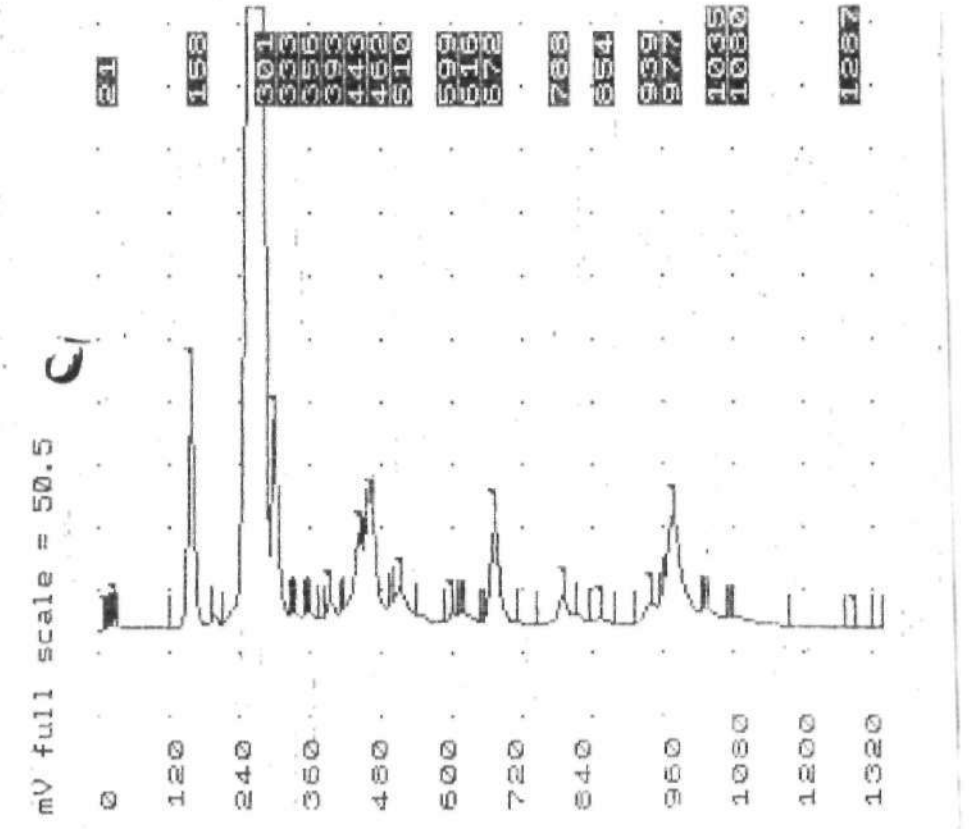


Fig. 20: Gas liquid chromatogram of E. camaldulensis oil. (Fr[illegible] leaves, Dry season)

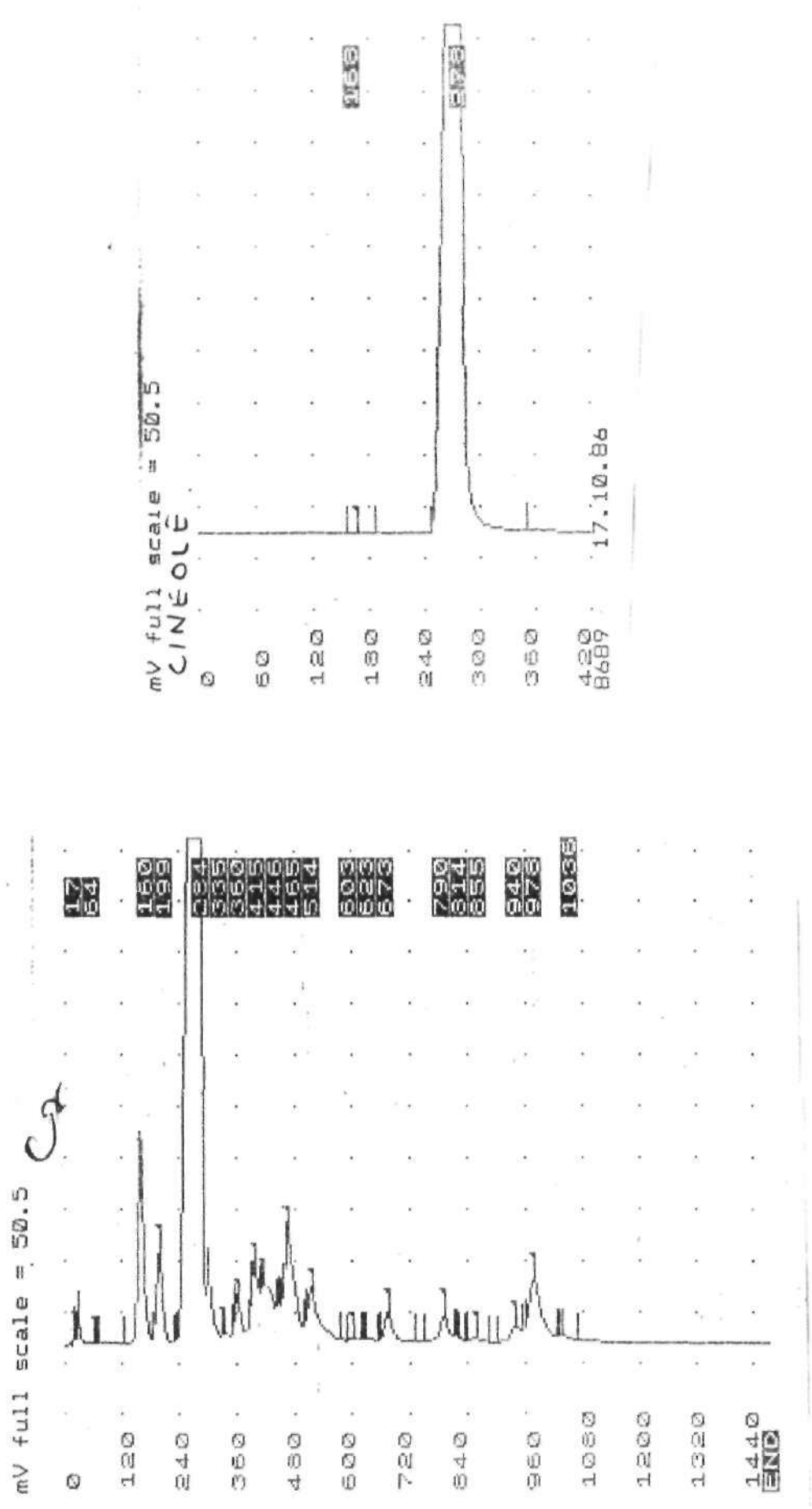
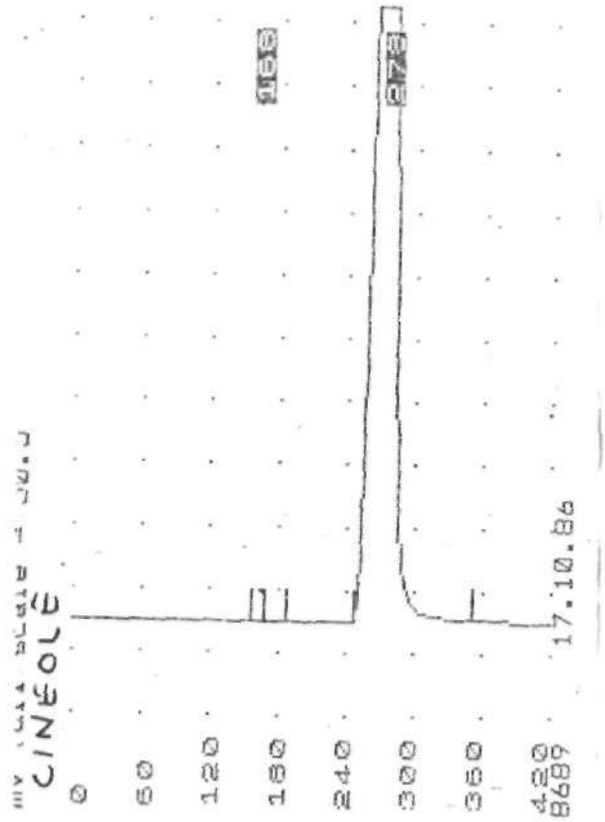


Fig. 21: Gas liquid chromatogram of E. [illegible]dulensis oil.
(Dry leaves, Rainy season)



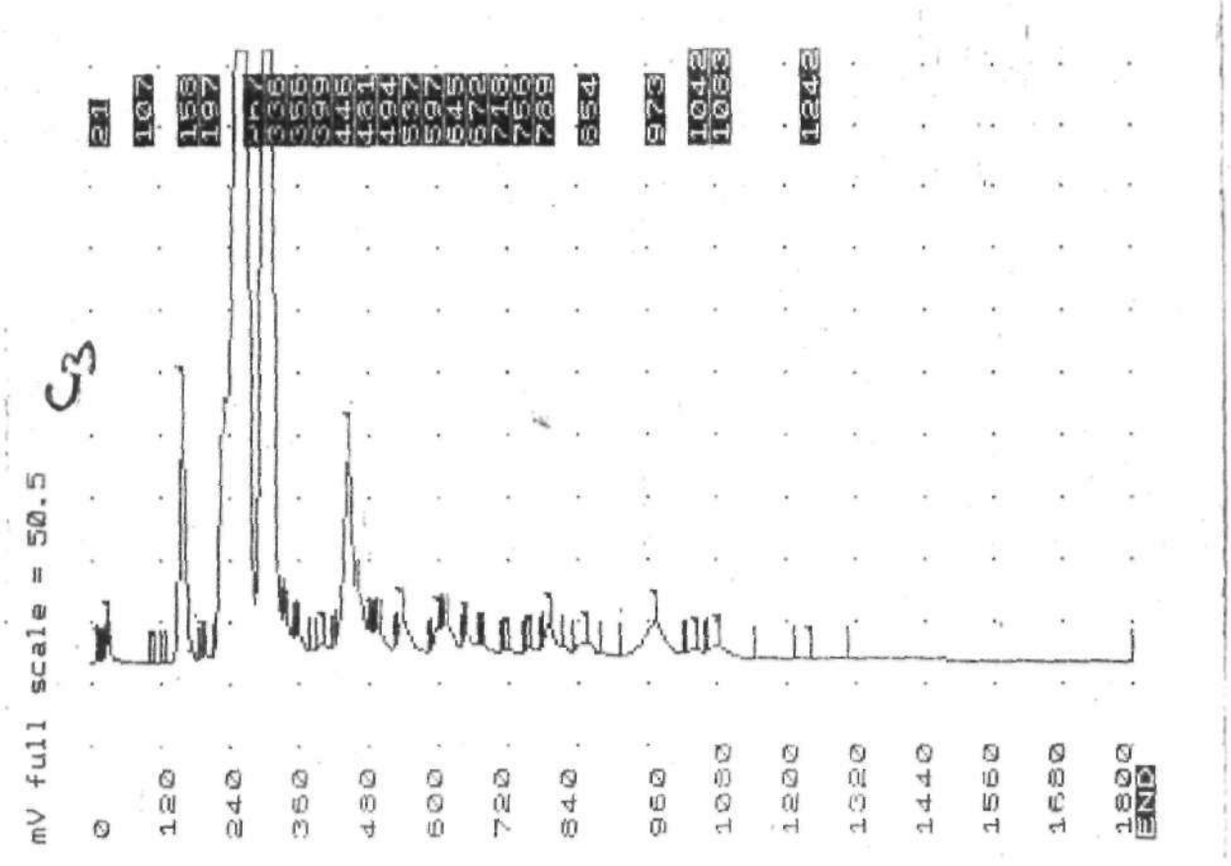


Fig. 22: Gas liquid chr[illegible]togram of E. camaldu[illegible]is oil. (Dry leaves, L[illegible] season)

Akinloye and Adegbehin (1984) suggested the use of the oil from this plant for antiseptic or antimicrobial purposes because of its higher aldehyde and low cineole contents.

The higher yield of citronellal in the oil from E. citriodora when the dried leaves are used may be responsible for the stronger odour perceived when the oil is extracted from the dry leaves in the rainy and dry seasons (see page 93).

Cineole, citronellal and two unknowns, which could not be identified due to lack of authentic samples, were the main constituents of E. tereticornis. There is a decrease in the cineole level in the fresh leaves extracted in the dry season.

When the oil rich in cineole is required, the fresh and dry leaves in the rainy season and the dry leaves in the dry season may be used.

Akinloye and Adegbehin (1984) also observed five major components in the oil from E. tereticornis. These were identified as cineole, citronellal, citronellol, phellandrene and an unknown.

In this experiment also, the presence of cineole and citronellal were confirmed. The proportion of the citronellol however was small.

GLC analysis showed cineole to be the main constituent of E. camaldulensis. The peaks were the

same in the dry leaf samples extracted in both the dry and rainy seasons and the fresh leaf samples in the dry season. There was no fresh leaf sample extracted in the rainy season for comparison. The above mentioned samples in the corresponding seasons may be used when oil rich in cineole is required.

The high cineole and low aldehyde contents of the oil would recommend it quite suitable for pharmaceutical use (Akinloye and Adegbehin, 1984).

Other works on E. camaldulensis growing in the Mediterranean regions of Turkey have also confirmed a similar higher cineole yield (Akinloye and Adegbehin, 1984).

The high quantity of the principal constituents of the volatile oils observed in the three Eucalyptus species when the dry leaf samples were used either in the rainy or the dry season may be due to the fact that the oil yield is highest at this time (Table 3).

4.6 MICROBIOLOGICAL STUDIES

In order to study the antimicrobial and antimycotic activities of the extracted oils, tests were carried out microbiologically on two bacteria (one gram positive and one gram negative) and one fungus. Standard microbiological techniques were used and the results obtained are summarised in Table 6

Table 6: Antimicrobial Effects of the Extracted Volatile Oils on Various Micro-Organisms (Disc Method)

Oils	Organisms		
	Escherichia coli	Staphylococcus aureus	Candida albicans
Lemon grass	++	++	++
Ocimum	++	++	+
Ginger	++	++	++
Clove	+	++	++
Orange (sweet)	+++	++	++
Tangerine	+	++	++
Eucalyptus citriodora	++	++	++
Eucalyptus tereticornis	++	++	++
Eucalyptus camaldulensis	++	++	++

Key:

1mm - 4mm = +

4mm - 8mm = ++

8mm and above +++

Results obtained have further confirmed the antibacterial effects of the oils. The oils have activity on gram positive and gram negative organisms and the fungus also.

Results also showed that the effect of the orange oil on Escherichia coli was more than the other oils. Tangerine and clove oils exhibited the least activity on the same organism.

All the oils had activity on Staphylococcus aureus and Candida albicans. The Ocimum oil however had weak antimycotic activity. Grover (1978) also showed this oil (Ocimum) to have antibacterial effect but weak antimycotic effect.

The antibacterial and antimycotic effects of the oils may explain why some of them have been used and are still being used in various local skin preparations to cure one form of skin disease or the other. Sofowora (1982) reported the use of oil from Ocimum gratissimum in skin cream formulations. Favourable results have also been reported following the use of this oil for certain dermatological disorders of microbial complications (Sofowora, 1982).

Akinloye and Adegbehin (1984) revealed the presence of citronellal, citronellol and cineole in the ratio of 45:4:1 in E. citriodora. The high aldehyde content of this plant may make it more suitable for antimicrobial

or antiseptic purposes. Also, a strong antimicrobial action of E. citriodora oil has been observed and this has been attributed to the synergistic actions of its high citronellal and citronellol content as opposed to the cineole content. The antibacterial effect of the oils justifies the uses of some of the oils like Ocimum, Clove, etc., locally in skin preparations like body pomades and hair shampoos to cure certain skin and scalp disorders. The uses also of some of the oils, e.g., incorporation of Ocimum oil into toothpaste for oral hygiene (Sofowora, 1972) and Cymbopogon citratus oil as a preservative, are based on their antiseptic properties (Olaniyi, 1985).

CONCLUSION

The project was carried out with the view to carrying out a preliminary research into some of the locally available plants that could be used as raw materials in cosmetic formulation and preparations. It was observed that there are numerous plant materials abundantly available in Nigeria, which could be useful in cosmetic industries. What remains is the encouragement by government, organisations or individuals to undertake research work on these plants for their proper utilization as raw materials for these industries.

The project carried out here concentrated only on some volatile oil-containing plants. The oils so obtained are important starting raw materials in the food and cosmetic industries. They are so used for their characteristic fragrance and colour which makes them useful in flavouring and colouring food and cosmetics. Our work has shown good quality and high yield of the volatile oils in the selected plants. The plants are therefore recommended for further exploitation for use in cosmetic preparations.

A justifiable reason for the local uses of some of the oils in skin preparations was found in their having profound antimicrobial actions in our microbiological experiments. The oils exhibited both antibacterial and antifungal properties. Thus they are justifiably used to cure skin diseases by local people.

A means of separating the individual components of the oils was also found by thin-layer chromatography (TLC). Benzene : ethylacetate (95:5) was found to be the solvent best suited for the effective separation of the constituents of the oils.

The chromatographic separation was necessary to determine the constituents of the oils and how best they could be separated for use. Not only that, the sample which could produce the highest yield was determined by this method for the different seasons. Gas chromatographic separation further confirmed which oil in a particular season contain a high quantity of the desired constituent for cosmetic and pharmaceutical uses.

Further research is necessary to establish ways and means of refining the oils and developing a formula for their uses in food and cosmetic industries. More research into local raw materials of plant origin is necessary now that cosmetic users are more aware of the relative safety of natural products from herbs than those of synthetic origin. Nigeria is a nation that has been blessed with numerous plants for such uses. Also, now that the country is facing economic recession and serious foreign exchange constraint, it is the right time to exploit this asset.

The foreign exchange scarcity has made the importation of some commodities including cosmetics

suitable for our skin type and weather is also necessary. On development such products can be exported to other parts of the world. This will serve as a foreign exchange earner too. Many European countries have perfected the art of herbal cosmetic preparations which have become more popular nowadays.

FUTURE OUTLOOK

Generally, the manufacture of cosmetics does not require heavy capital investment, nor excessive labour. The profit obtained from the resulting manufactured products is high in relation to the direct manufacturing costs.

The future outlook for cosmetics and toilet goods is dependent on a number of factors such as economic conditions, population trends, fashions, scientific progress and government involvement. The cosmetic and toiletry usage has been relatively immuned to economic conditions. A number of factors listed below will favour the continued growth of a cosmetic industry in Nigeria.

1. Population growth: There is continued population growth annually. The teen and young adult market is growing at a much faster rate and this group represents the heaviest users of cosmetics and toiletries.

2. Influence of youth: In addition to their growing number, the youth market has taken leadership in all aspects of fashion including the use of cosmetics.

3. Male market change: Young men have broke away from the traditions that cosmetics and toiletries uses are un-manly. They have shown a willingness to use grooming

products and try new product categories that their fathers would never have considered.

4. Working women: They constitute the heaviest users of cosmetics. As their numbers grow in the work force, as is happening now, they will have more money to spend on cosmetics and toiletries. Working women have greater need for these products than women who stay at home.

5. Shift from rural to urban living: Urban dwellers spend much more on cosmetics and toiletries because of the type of work, social pressure, fashion need and higher income. More people move to urban areas from rural areas yearly.

6. Continued heavy promotion: Increased promotion and advertising of cosmetics and toilet goods have resulted in higher awareness of this category.

With more research and the development of new products, the improvement of old products and imaginative advertising and promotions, the field of cosmetic users and uses should continue increasing. With the ever-increasing population and more money to spend, there is every reason to believe that the cosmetic and toilet goods industry has a promising future in Nigeria.

The government and private pharmaceutical firms or individuals should encourage the research and establishment of cosmetic manufacturing units in the country. The aggressive and corrective measures taken by the Federal Government will revitalize the economy and the cosmetic industry will continue its healthy growth trend.

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