

STUDIES ON COLOUR YIELDING COMPONENTS OF PLANTS

Part (1) : Extraction of colouring materials from Jak (*Artocarpus integrifolia*), Sepalika (*Nyctantus arbortristis*) and Bowitiya (*Osbeckia aspera*).

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In the remote past, the main source which supplied the needs of human beings was the forest and it was exploited to satisfy most of their needs. Hence ancient people turned to the plant kingdom to obtain various dyes which gave the most delightful colours.

Several plants such as Woad (*Isatis tinctoria*), Madder (*Rubia tinctoria*), Log wood (*Haematoxylon campeachianum*), Indigo (*Indigofera tinctoria*) and Brazil wood (*Caesalpinia sappan*) were distributed all over the world and were known for their brilliant colours.¹ As plenty of these plants were available, decoctions of these plants or parts of plants were used for dyeing purposes. For convenience in transportation and utilisation, people used to separate colouring principles of individual plants by using various extraction methods. Some of these dyes were modified as required to suit various dyeing processes eg, a water insoluble form of indigo dye was used in Vat-dyeing of cotton.²

With the advent of modern scientific techniques, the chemistry of these colouring principles was unravelled and the same compounds were synthesised from petroleum by-products. Almost all of these synthetic dyes became popular among ordinary people because of their high staining power and low cost. Hence the use of natural dye stuff was restricted to the food industry where the nontoxic nature of these ingredients was highly favoured.

However, there is another factor at work in countries like Sri Lanka. Many such countries face severe balance of payment problems and with the rising price of crude oil, synthetic dyes will be beyond their reach. A few years ago with the restriction of imports, a situation arose which prompted local research workers to investigate the possibilities of obtaining dye extracts from locally available plants.

During our course of study, a large number of dye yielding plants and dyeing recipes that had been used by our ancestors were investigated.³ Several modern techniques for the extraction of colouring matters from selected species were attempted.

This paper deals with three different extraction procedures that were used for the extraction of colouring matter from heart wood of Jak, flowers of Sepalika and fruits of Bowitiya. From the various extraction methods we have attempted, these three were selected to be the most suitable methods for the extraction of colouring compounds of the given plant materials.

1. Extraction of colouring matter from heartwood of Jak

1.1 Method of extraction of colouring matter with water using Soxhlet Apparatus:-

Air dried saw dust of heart wood of Jak was packed in the extraction chamber of a soxhlet apparatus. Extraction was carried out with water until the extract passing through the syphon was colourless. The brownish yellow liquid thus obtained was evaporated on a steam bath. The Solid crude extract obtained was ground with acid washed sand and was packed into a smaller soxhlet extractor. This material was successively extracted with acetone followed by methanol.

1.2 Method of extraction of colouring matter with dilute Sodium Hydroxide solution.

100 g of air dried saw-dust was mixed with one litre of 0.5% solution of Sodium Hydroxide. The mixture was vigorously stirred with a glass rod and left for 10 minutes. Then the extract was filtered and extraction was repeated twice using 500 ml portions of Sodium Hydroxide solution. Combined extracts were slightly acidified using dilute Hydrochloric acid. On heating the solution up to 70° C the precipitate formed coagulated and it was separated by filtering through a cheese cloth. The solid colouring matter thus obtained was washed with water and dried in a dessicator. It was further purified by extracting with acetone. The purity of these extracts was checked using thin layer chromatography.

2. Extraction of colouring matter from flowers of Sepalika

20 g of air dried flowers were boiled with 500 ml of water for 30 minutes. The extract was filtered and the flower residue was repeatedly extracted three times with water. The combined extract was concentrated to about 15 ml by evaporation. The thick syrupy extract thus obtained was cooled and stirred with 50 ml of rectified spirit with the aid of a glass rod. Brown coagulum deposited was removed. The yellow solution obtained was centrifuged and the supernatant liquid was stored in a stoppered bottle.

3. Extration of colouring matter from fruits of Bowitiya

100 g of fresh ripe fruits of Bowitiya were macerated with 200 ml of rectified spirit in a high speed macerator for 10 minutes. The extract was filtered and the residue was repeatedly extracted with 2×200 ml of 75% rectified spirit. Filtrates were combined and passed through a column of activated Amberlite 15 cation exchange resin at a rate of 5 ml per minute. The column was washed with rectified spirit. The colouring matter regained on to the column was eluted with 5% HCl/ rectified spirit. Elutant was concentrated at 40°C, using a rotary evaporator.

4. Results

4.1 Water extract of Jak wood :-

Weight of saw dust used	=	100 g
Moisture content	=	15.5%
Wt. of crude extract obtained	=	5.23 g
Dry wt. of acetone extract	=	2.91 g
Dry wt. of methanol extract	=	0.92 g

4.2 Sodium hydroxide extract of Jak wood :-

Weight of saw dust used	=	100 g
Moisture content	=	15.5%
Wt. of crude extract	=	7.32 g
Dry wt. of acetone extract	=	2.61 g
Dry wt. of methanol extract	=	0.88 g

4.3 Water extract of flowers of Sepalika :-

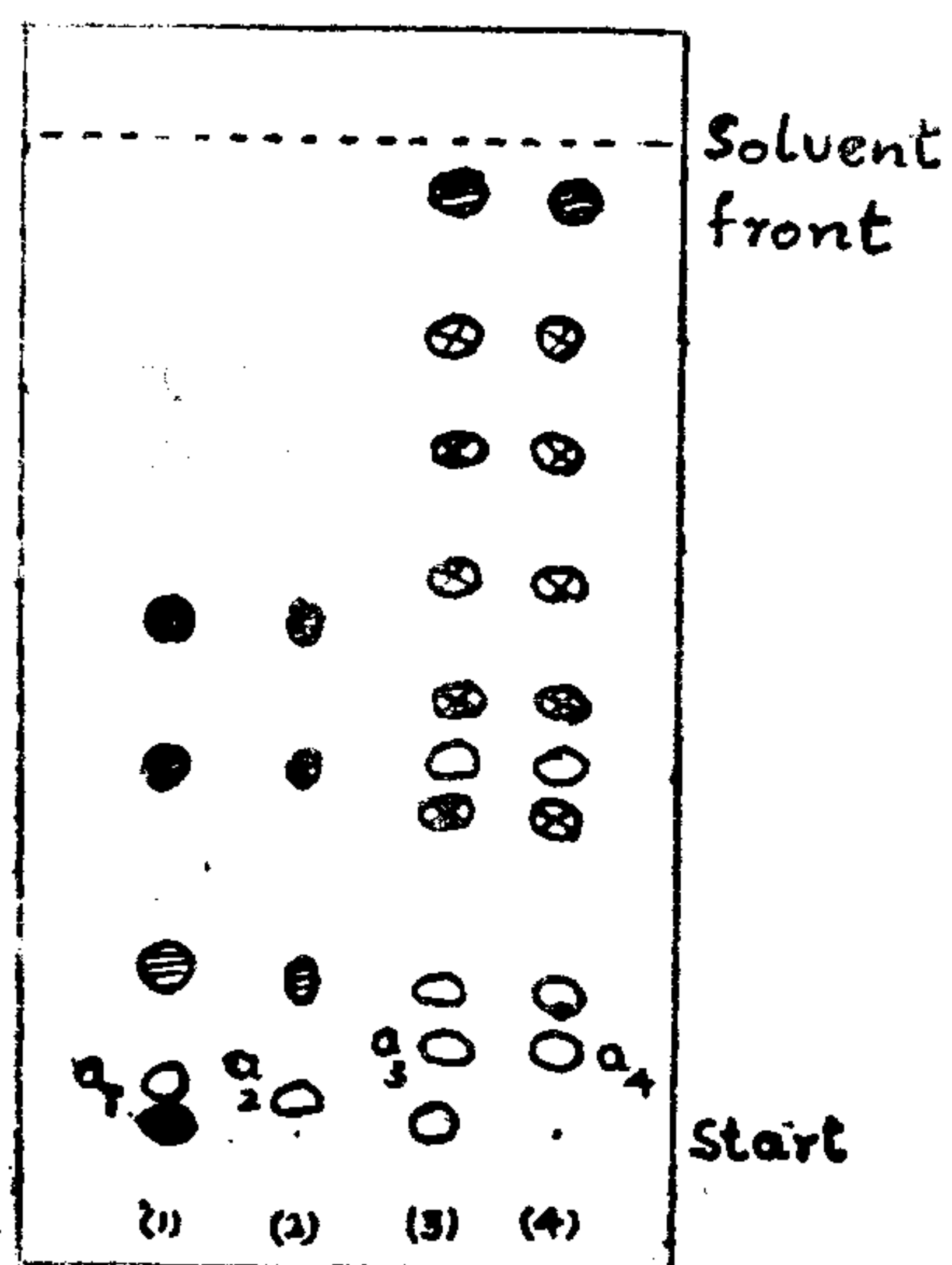
Weight of flowers used	=	20 g
Moisture content	=	14.0%
Wt. of colouring matter obtained after purifying with 80% ethanol	=	2.7 g

4.4 Ethanol extract of fruits of Bowitiya :-

Wt. of fresh fruits used for the extraction	=	100 g
Moisture content	=	79.0%
Dry weight of crude extract	=	6.5 g
Wt. of colouring matter obtained after purifying the extract	=	0.84 g

3.0 T.L.C. Patterns of extracts obtained

3.1 Extracts of Jak wood



- (1) Crude water extract of Jak wood
- (2) Partially purified water extracts of Jak wood
- (3) Crude sodium hydroxide extract of Jak wood
- (4) Partially purified sodium hydroxide extract of Jak wood

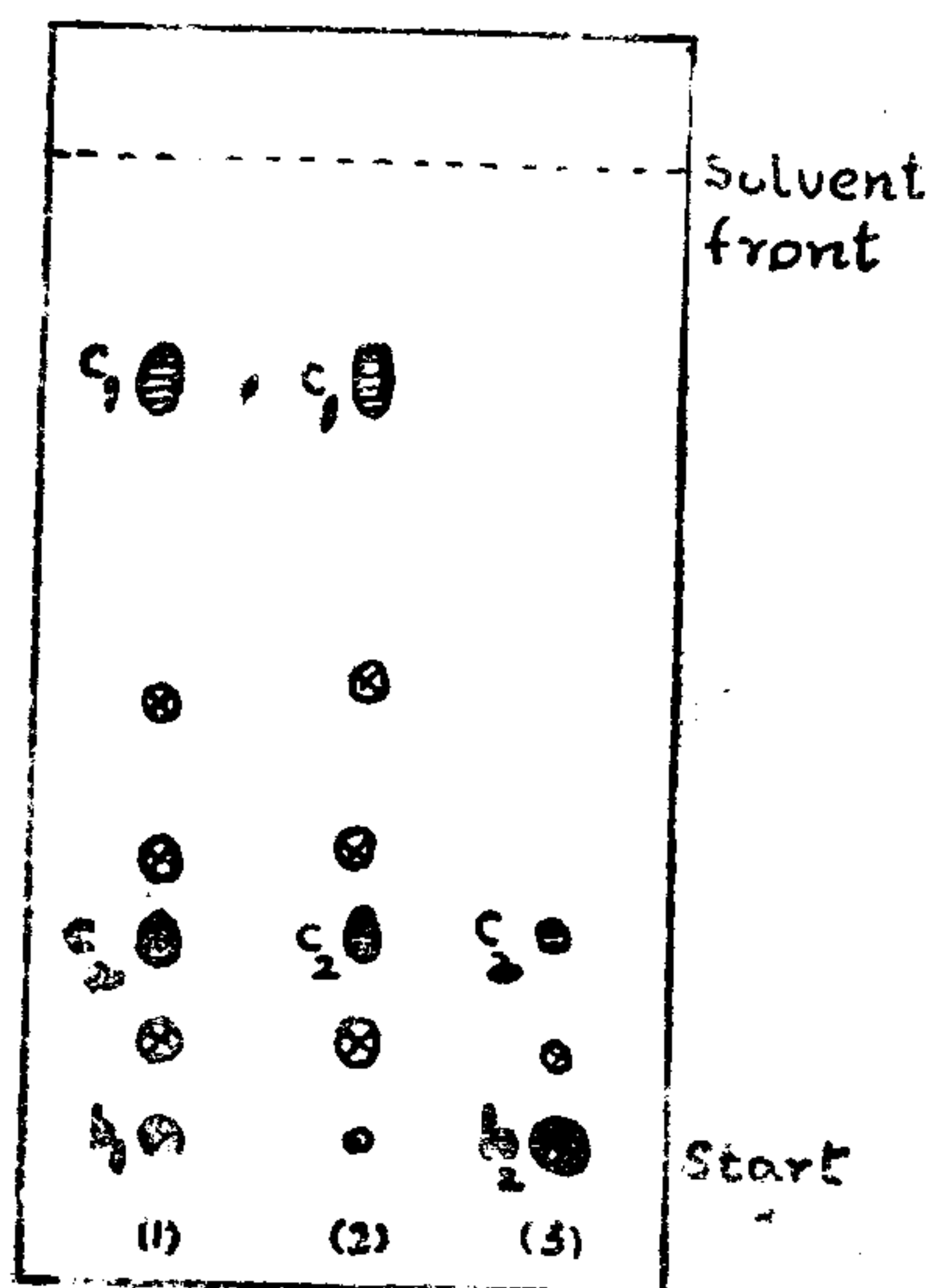
Spots $a_1 - a_4$ were yellow. Under U.V. light they gave bright yellow fluorescence.

Spots marked as (x) became yellow after exposing to ammonia vapour.

Impurities present in samples are denoted by other spots which appeared after exposing to Iodine vapour.

FIG. 1
Sorbent Silica Gel Gf₂₅₄
Solvent.⁴ Acetone Benzene (2:7)

3.2 Extracts of flowers of Sepalika



- (1) Crude water extract of flowers of Sepalika
 - (2) Partially purified water extracts flowers of Sepalika
 - (3) Purified Water extracts.
- (x) yellow
(b) Brown spots
(c) other colourless impurities (became brown on exposure to Iodine vapour)

FIG. 2
Sorbent : Silica Gel GF₂₅₄
Solvent : Ethyl acetate-Methonal-⁵-Water (100:16.5:13.5)

3.3 Ethanol extract of fruits of Bowitiya

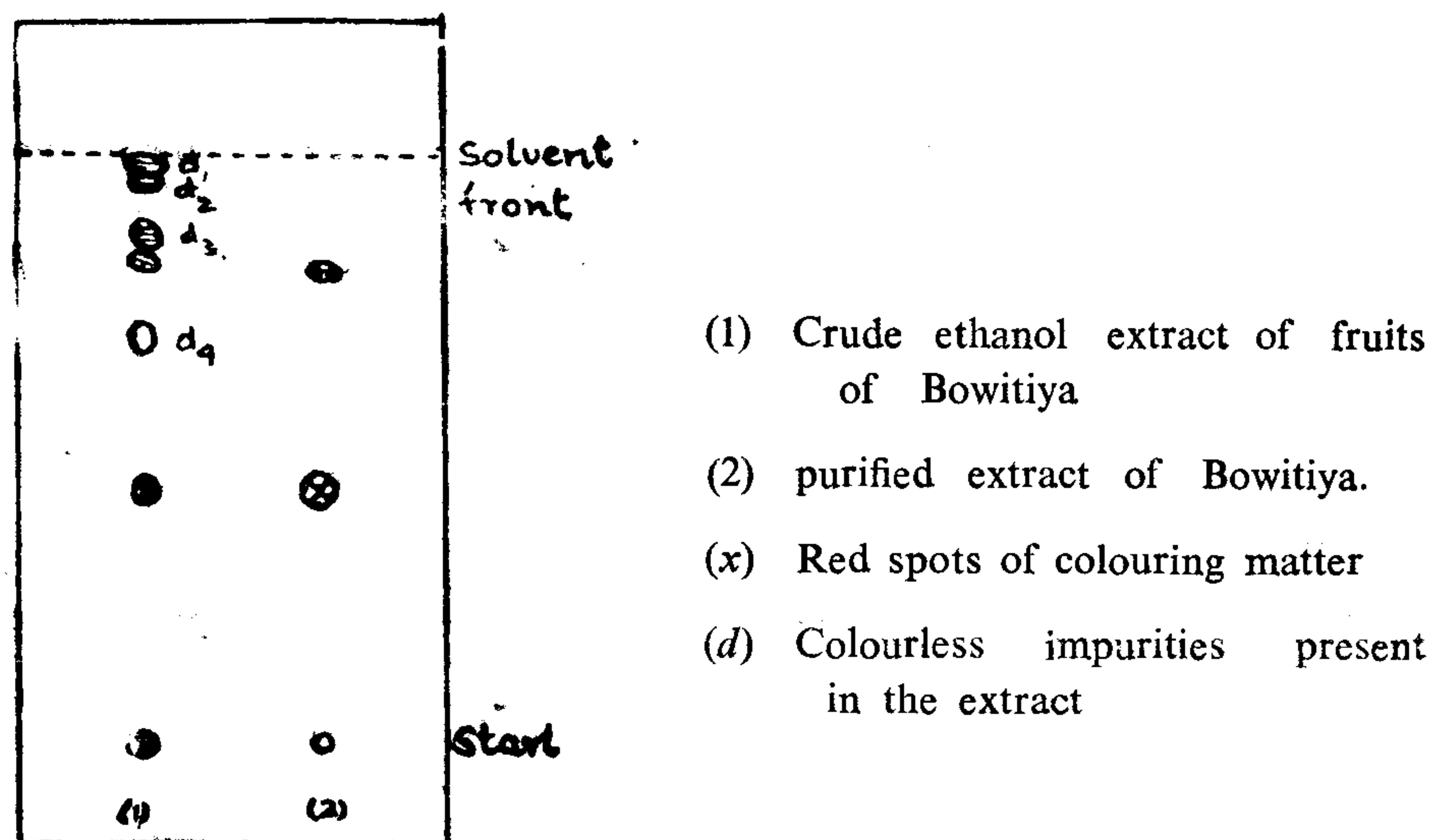


FIG. 3

Sorbent : Silica Gel EF₂₅₄
 Solvent : Ethyl acetate - Acetone -
 Formic acid - Water (9:3.1.1.)

4.0 Discussion

In the selection of raw materials, two important factors were considered. They were (a) Availability of raw materials and (b) General properties of colouring principles and the purpose for which it is intended to be used. In Sri Lanka, wood of Jak is widely used in carpentry. Unfortunately a large amount of this valuable wood is wasted as saw dust and wood shavings. It has a potential as a source of colouring material for cloth, fibre etc.

As the water soluble fractions of flowers of Sepalika and fruits of Bowitiya are known to be non-toxic in nature, they may possibly be used as food dyes. These plants are also abundant in Sri Lanka and bear flowers and fruits throughout the year.

The advantage of the extraction methods 1.1, 1.2 and 2 is that the amount of organic solvents required is less, compared to the other methods. But the loss of colouring matter during extraction and concentration was comparatively high in these extraction methods.

However the cold extraction method described for the extraction of colouring matter from Bowitiya was more suitable since almost all impurities could be removed by this method.

Although the yield from the sodium hydroxide extraction method for Jak was higher than that of the water extraction method, the end products obtained by the former method mainly consisted of colourless fractions which were not soluble in water. But they completely dissolved in mild alkaline solutions such as ammonia and sodium carbonate giving bright yellow solutions. For this reason, applications of this dye are restricted to where dyeing should be carried out in basic media.

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