



Formulation, Preliminary Evaluation and Antimicrobial Activity of a Herb Based Kohl

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Abstract

Kohl's have been used since antiquity in various civilizations of the world, and dates back to the Bronze Age. It is chiefly used by the females of South Asia, Middle East and Africa. It is known as "qwalli" in West Africa and "surma", "kajal", or "kaadige" in South Asia. The most commonly used ingredient of kohl being galena has always been subjected to widespread criticism in view of lead intoxication. The concerns are even more grave since kohl finds greater acceptability in women and infant population. In light of these facts, a herbal kohl was formulated and evaluated. Herbal kohl was formulated and scientific intent was used for selection of ingredients. The herbal kohl was evaluated on selected parameters and its antimicrobial potential was compared with comparator products. Findings revealed that the test product afforded a decent antimicrobial efficacy and was cosmetically acceptable as indicated by pH, viscosity and particle size analysis and physical evaluation. The herbal kohl formulated showed antimicrobial activity, the major concern of the study; hence a test product with beneficial properties could be sought since kohl remains by far the most popular eye cosmetic especially amongst women.

Keywords: Kohl, kajal, herbal kohl.

Introduction

Eye cosmetics are as old as vanity. For thousands of years the people of ancient civilizations decorated their eyes with colorful substances in order to enhance their facial appearance.

One of the first known eye-shadows was the green ore malachite ($\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$) used as long ago as 5000 BC. ¹ Eye paints were nearly universal across North Africa, the Middle East, and South Asia. The black paint provided relief from the glaring sun and reflection from the sand before sunglasses were invented. Lamp-black was the most common source of pigment, though galena, (lead sulphide), and stibnite (an antimony compound), were also used for black, and copper compounds for blues and greens. In the Bronze Age Sumer, women used eye shadow made of finely ground malachite, a green-blue mineral. Malachite occurs naturally as a surface mineral in the Sinai, and was carried across the trade routes into Egypt and the Middle East. Canaanite women painted their eyelids with stibnite. Stibnite occurs in large deposits near Lake Urmia, in Armenia and Afghanistan, Egyptians used galena (lead sulphate) and powdered malachite to outline their eyes. Ancient Egyptian men and women wore eye paints from childhood, throughout their lives, and were adorned in death. They laid eye cosmetic pouches and applicators

in tombs for use in the afterlife. Even the statues of Egyptian gods had their eye paints reapplied daily.

Pliny and Dioscorides describe the manufacture of black eye paint by Ancient Egyptians: galena was pounded with frankincense and gum, and then mixed with goose fat. It was put in dough or cow dung and burned. The burning drove sulphur out of the galena to form lead oxide. This was quenched with milk, and then pounded in a mortar with rainwater. This was decanted several times and the finest powder was collected, dried, and divided into tablets. Each woman would pulverize these and keep them in her cosmetic jar for application.

In Rome, women painted their eyelids and brows with a black eye cosmetic, "Illa supercilium, madida fulgine tactum oblique producit acu, pingitque, trementes Attolens oculos". They applied the color to their eyes by dipping a feather into prepared soot and pulling it between their nearly closed eyelids. In the 6th century, Alexander of Tralle described kohl's made of burnt cadmium, copper, acacia gum, aloes, spikenard, opium, myrrh, lead, burnt ebony and copper, roses, and rainwater. In the 17th century, Celsus described twenty-six formulae for kohl and collyria. Five used stibnite, eight used burned copper, and others used lead, ash from fragrant woods, verdigris, and copersas.



Some women believed that blackening their eyelids and eyebrows would protect them from the glance of the “evil eye”, and also prevent them from transmitting the evil eye to another person. Most women applied kohl every week, or for any social occasion, except during Ramadan, when kohl and all hennas were set aside. In Afghanistan, women made surma by pounding antimony with almond oil to make a paste, and applying it with a small wood stylus, called a mikh.

Most women created their own cosmetics. Wealthier people used soot from burning amber or aloe wood to make their eye paints; poor women used common pot-black and animal fat. Jews were often formulators and sellers of cosmetics through North Africa and the Middle East.²

Kohl

It is worn for a variety of reasons including tradition, beautification, to ward off the “evil eye,” the widespread belief that kohl is medically beneficial for the eyes, and finally because wearing kohl is encouraged within the sunna, the traditional behavioral guidelines of the Islamic religion.³

Synonyms

Kajal, Al-kahal, Kuhl, Soorma, Ithmid.

Definition and Terminology

Primarily, the word “kohl” is Arabic in origin and in actual the Arabic oculist called it as “kahal”

In the Eastern system of medicine (Unani/Ayurvedic) and Greko-Arabic system of medicine, kohl has been defined as ultra fine powder containing one or more ingredients (such as galena, herbs, pearls, gemstones etc.) to be used in the eyes for prophylaxis and treatment of various eye diseases.

However a more scientific and precise definition is forthcoming: kohl (surma) may be defined as an eye preparation in ultra fine form of specially processed “kohl-stone” (galena) incorporated with some other therapeutically active ingredients from marine, mineral and herbal origin for the protection and treatment of various eye ailments. The other ingredients blended to develop special kohl formulation may include kohl adjuvant, (e.g., zinc oxide, silver leaves, gold leaves), gemstone (e.g., ruby and emerald etc.), marine coelenterates (e.g., coral, coral reef and pearls etc.) and herbs (e.g., neem, saffron, mumeera and fennel extract etc.).

Efficacy Claims

Perhaps, kohl is the most popular eye product reported in almost every human civilizations used to keep the eyes cool and clean and for the prevention and treatment of eye diseases such as, blepharitis, trachoma, chalazion, pterygium, cataract, conjunctivitis, ectropion, as well as for the prevention of recurrence of trichiasis. Further, kohl is also reported for improvement of vision, strengthening and keeping the eyes healthier. One of the most striking properties of kohl has been observed in Arabian Peninsula. It was reported that the black and shiny particles of galena or

lead sulphide (a major constituent of kohl) shield the eyes from the glare and reflection of sun and thus protects the eyes from the harmful effect of UV rays emerging from the sun and dust of the desert. Some more references relating to solar absorption, photo resistant, humidity and temperature sensor and solar properties of galena (lead sulphide) have also been reported by various authors.⁴ It has also been advocated to be astringent for eye injuries and umbilical stump and also used in teething powders (teethers).⁵

Criticism

Originally, ‘kohls’ in Arabia were made of antimony trisulfide and the ore stibnite was called ‘ethmid’. As this was scarce and expensive, it was slowly replaced over the years by galena (lead sulfide) which has the same grey-black colour and shiny appearance like stibnite.⁶

Lead intoxication following application of kohl resulting from galena “kohl-stone” has been a major area of criticism.^{7,8,9} Elevated blood lead levels in Omani children indicative of subclinical lead intoxication, following treatment with lead containing traditional medicines have been reported. The widespread use of such lead containing ‘kohls’ and other medications in the Middle East should thus be considered as a definite source of potential lead poisoning. Another report also indicates lead poisoning in children in the Middle East due to the use of such remedies. This is of great concern as children are more susceptible to lead intoxication. Application of kohl to a child’s eyes or to the umbilical stump at birth has been implicated as a possible determinant of elevated blood lead levels in young Saudi Arabian school girls. Use of lead containing traditional remedies in neonates and in young children has been known to result in lead encephalopathy. Acute lead encephalopathy in infants following the use of traditional medicines has recently been reported to occur even when blood lead levels were only 56.9 mg/dl (70 mg/dl is the proposed threshold for encephalopathy). In adults elevated blood lead levels due to the use of kohls have also been reported. An increase in the risk of trachoma in Saudi men who were kohl users has been documented suggesting that transmission of infection is an added risk factor in kohl usage.⁶

On the contrary there are studies which are of a view that lead is not absorbed through transcorneal route and thus should not be linked or blame for increased blood lead level and lead poisoning after its application.¹⁰

However kohl is unapproved for cosmetic use in the United States since there have been reports linking the use of kohl with lead poisoning in children.^{11,12}

With a say for the criticism following kohl-stone, herbal kohl was formulated in our laboratory and successively evaluated on certain parameters.

Materials and Methods

Formulation of Herbal Kohl

The product was formulated as described under:

Almond oil soot (3.0 g), Castor oil (2 drops), Mentha ex-



Figure 1. Particle size analysis using Camera Lucida

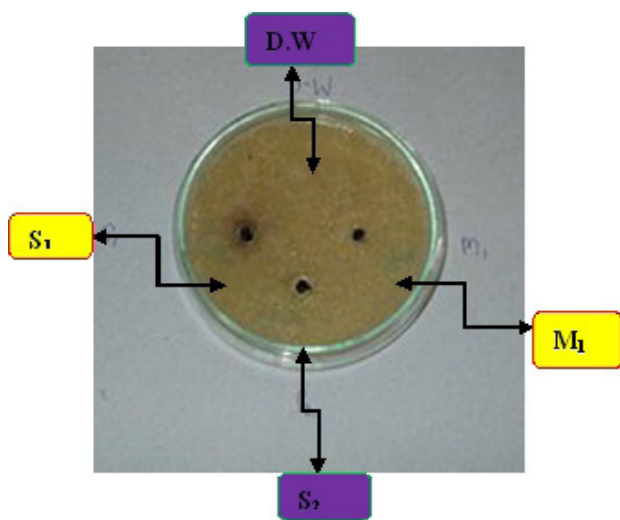


Figure 2. Antimicrobial Studies – Cylinder Plate Method I.P. 1996

tract (3 drops), *Ocimum* extract (3 drops), *Vitex* extract (2 drops) and vegetable ghee (q.s).

Almond oil was burnt and its carbon black was collected. Aqueous extraction was followed on the fresh leaves of the selected plants, i.e. *Mentha piperita* Linn, *Ocimum sanctum* Linn, and *Vitex negundo* Linn. Plant extracts were incorporated drop wise in the almond oil soot and castor oil was also added to it. Lastly vegetable ghee was used in desired proportion to dough out the preparation.

Rationale

Mentha piperita Linn, commonly known as peppermint, brandy mint or candy mint (Vilayati podina in Hindi), belonging to family lamiaceae, is a popular medicinal plant in many traditional systems of medicines.¹³ The principal active constituents of *Mentha piperita* are the essential oils, which comprise about 1% of the herb. The oils are dominated by monoterpenes, mainly menthol, menthone, and their derivatives (e.g., isomenthone, neomenthol, acetylmenthol, pulegone). These essential oils dilate peripheral blood vessels and inhibit bacteria. Its oils especially menthol have a broad spectrum antibacterial activity since Gram +ve and Gram -ve bacteria were found susceptible to the oils.¹⁴

Ocimum sanctum L. commonly known as holy basil (Tulsi in Hindi), belonging to family lamiaceae is a small herb seen throughout India. Eugenol (1-hydroxy-2-methoxy-4-allylbenzene), the active constituent present

Table 1. Viscosity measurements.

S.No	RPM	Dial Reading % Torque	Factor	Viscosity = Dial reading X Factor (Centipoise)
1	10	9	4000	36000
2	20	10.5	2000	21000
3	50	12	800	9600
4	100	13	400	5200

Average Viscosity: $36000+21000+9600+5200/4 = 17950$ Centipoise

in *Ocimum sanctum* L., has been found to be largely responsible for the therapeutic potentials of Tulsi. The leaf juice of *Ocimum sanctum* L. along with Triphala is used in Ayurvedic eye drop preparations recommended for glaucoma, cataract, chronic conjunctivitis and other painful eye diseases.¹⁵

Vitex negundo L. commonly known as five-leaved Chaste tree or Monk's Pepper (Nirgundi in Hindi), belonging to family Verbanaceae is used as medicine fairly throughout the greater part of India. Leaves are rich in an alkaloid nirshindine and also a source of flavonoids. The plant is bitter, astringent and ophthalmic. It finds use in ophthalmology.¹⁶ Castor oil obtained from *Ricinus communis*, family Euphorbiaceae is recommended in dry eye treatment; blepharitis and evaporative dry eyes.

Almond oil is the fatty oil obtained from cold expression of ripe seeds of *Prunus communis* belonging to family Rosaceae. It finds mention in many traditional practices for treating eye diseases.¹⁷

Evaluation of Herbal Kohl

Physical Evaluation: The formulated product afforded a shiny black color, with a characteristic odor. It was smooth and non-gritty in texture with a semisolid consistency.

pH Determination: Read as 7.2 from pH meter.

Viscosity Determinations: Using Brookfield Viscometer (Model RV and Spindle no.7).

Evaluation of Base: Vegetable ghee¹⁸ was evaluated for acid value, Saponification value and ester value as per I.P. 1996.

Acid Value: Acid Value = $5.61 \times n/w$; where n = no. of ml of 0.1 M KOH required and w = weight in grams of solvent; where n = 0.5 and w = 2.0 Hence Acid value equals to $5.61 \times 0.5/2 = 1.4025$

Saponification Value: Saponification value equals to $28.05 (b-a) / w$; Where w = weight in grams of substance, b = blank solution reading, a = sample solution reading; b = 21, a = 4.6, w = 2.0 Therefore, Saponification value = $28.05 (21-4.6) / 2 = 230.01$ Ester Value: Ester value = Saponification value – Acid value Hence Ester value = $230.01 - 1.4025 = 228.6075$.

Formulation of Control for Antimicrobial Studies

Composition: Almond oil soot (3.0 g), Chloramphenicol (1.5 g; 6 applicaps, equivalent weight = 250 mg/ applicap) and vegetable ghee (q.s).

Method and Rationale: Almond oil was burnt and its carbon black was collected on a clean china dish. Chloram-

Table 2. Particle Size Analysis (Using Camera Lucida)

S.No.	L	W	A	Asp Ratio	R	S	BA	CX	CY	E	O
1	6.342	2.632	13.85	2.41	22.222	0.045	13.85	295	153	4.5	90
2	6.342	2.632	13.85	2.41	22.222	0.045	13.85	313	149	4.5	0
3	6.342	2.632	13.85	2.41	22.222	0.045	13.85	64	265	4.5	90
4	7.432	3.72	27.701	1.998	33.333	0.03	27.701	83	255	4	45
5	6.342	2.632	13.85	2.41	22.222	0.045	13.85	222	225	4.5	90
6	3.711	2.632	6.925	1.41	100	0.01	6.925	62	245	4	0
7	7.432	3.72	20.776	1.998	33.333	0.03	20.776	497	79	4.581	45
8	8.974	2.632	20.776	3.41	33.333	0.03	20.776	583	140	5.333	90
9	7.432	3.72	20.776	1.998	33.333	0.03	20.776	561	235	4.581	135
10	3.711	2.632	6.925	1.41	100	0.01	6.925	537	248	4	0
11	7.432	3.72	20.776	1.998	33.333	0.03	20.776	494	298	4.581	45
12	3.711	2.632	6.925	1.41	100	0.01	6.925	468	276	4	0
13	7.432	2.632	27.701	2.824	44.444	0.023	27.701	124	287	4.866	45
14	8.974	5.263	27.701	1.705	44.444	0.023	27.701	100	237	4.866	0
15	8.974	7.895	34.626	1.137	55.556	0.018	34.626	417	126	4.646	90

CD	SV	MjA	MnA	TL	TW	FL	FW	MnR	MxR
8.401	44.805	6.342	0	5.263	2.632	7.895	1.754	1.861	4.492
8.401	44.805	6.342	0	5.263	2.632	7.895	1.754	1.861	4.492
8.401	44.805	6.342	0	5.263	2.632	7.895	1.754	1.861	4.492
11.881	126.727	7.432	0	5.263	5.263	10.526	2.632	1.861	5.582
8.401	44.805	6.342	0	5.263	2.632	7.895	1.754	1.861	4.492
5.94	15.841	3.711	0	2.632	2.632	5.263	1.316	1.861	1.861
10.289	82.312	7.432	0	6.614	3.141	9.755	2.13	1.861	4.492
10.289	82.312	8.974	0	7.895	2.632	10.526	1.974	1.861	4.492
110.289	82.312	7.432	0.31	6.614	3.141	9.755	2.13	1.861	4.492
5.94	15.841	3.711	0	2.632	2.632	5.263	1.316	1.861	1.861
10.289	82.312	7.432	0	6.614	3.141	9.755	2.13	1.861	4.492
5.94	15.841	3.711	0	2.632	2.632	5.263	1.316	1.861	1.861
11.881	126.727	7.432	0	8.255	3.356	11.611	2.386	1.861	4.492
11.881	126.727	8.974	0.155	8.255	3.356	11.611	2.386	1.861	4.492
13.283	177.107	8.974	5.582	8.708	3.976	12.684	2.73	4.492	4.492

L = Length, W = Width, A = Area, R = Roundness, S = Shape, BA = Box area, CX = Centroid X, CY = Centroid Y, E = Elongation, O = Orientation, CD = Circle diameter, SV = Sphere volume, MjA = Major axis, MnA = Minor axis, TL = Thread length, TW = Thread width, FL = Fibre length, FW = Fibre width, MnR = Min radius, MxR = Max radius

Table 3. Observations (Zone of inhibition; n=3)

S. No	Sample	Zone of inhibition diameter (cm)
1	D.W	0.0
2	S ₁	0.2
3	S ₂	0.5
4	M ₁	0.1

phenicol was incorporated in the soot and vegetable ghee was used to dough out the preparation. Chloramphenicol is prototypic broad spectrum antimicrobial agent. This nitrobenzene derivative is effective against a wide range of gram positive and gram negative bacteria, including most aerobic organisms and is used topically in eye infections.

Results

Herbal kohl was formulated and evaluated on various parameters. The pH, viscosity (Table 1), and particle size analysis (Table 2, Fig 1) followed expected significance. The base satisfied the evaluated parameter values (acid value, Saponification value and ester value) and physical evaluation was suggestive of a cosmetically appealing product.

A control was formulated for antimicrobial studies and a general antibiotic assay was conducted to evaluate the comparative antimicrobial potential of the test, control, comparator and distilled water. Composition of nutrient agar I.P and cylinder plate method was employed. As evident from the diameters of zone of inhibition (Table 3)

observed for each sample a comparative order of antimicrobial efficacy deduced is as follows:

$$S_2 > S_1 > M_1 > D.W$$

- D.W = Distilled water
- S_1 = Test (with plant extracts)
- S_2 = Control (with chloramphenicol)
- M_1 = Marketed preparation (identity concealed)

Discussion

Maximal antimicrobial response was shown by the control formulation containing chloramphenicol (1500mg) which is a nitrobenzene derivative with broad spectrum of activity. Test formulation enriched with aqueous plant extracts showed significant antimicrobial potential which was lesser than control but greater than the marketed formulation. The marketed formulation showed antimicrobial potential lesser than the test formulation as suggestive from the zone of inhibition measurements. pH value satisfied the pH requirement for ophthalmics and particle size analysis suggested a non gritty product. Viscosity and physical evaluation complied with cosmetic acceptability.

The herbal kohl formulated with a view to serve the dual purpose of an eye cosmetic as well as keeps the eyes healthy and free from infections was evaluated on different parameters. The results of various determinations are suggestive of an acceptable and elegant product.

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