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Research Article

Formulation and Evaluation of Cosmetic Gel Using *Maranta Arundinacea* L.

SUNDHARARAJAN Ranganathan [1]*, RAJALAKSHMI Gopalakrishnan [2], RESHMA Chittettu Shajimon[3], ROHINI Perumbilavil Elamkuttivalapil[3], SANTHIYA Suresh Kumar[3], MINHAJUDEEN Abdullah[3], SANGEETHA Ravi [3]

[1] *Professor and Principal, Mohamed Sathak AJ College of Pharmacy, The Tamilnadu Dr. M.G.R.Medical University, Sholinganallur, Chennai 119.*

[2] *Professor Incharge, Department of Pharmaceutics, Mohamed Sathak AJ College of Pharmacy, The Tamilnadu Dr. M.G.R.Medical University, Sholinganallur, Chennai 119.*

[3] *Mohamed Sathak AJ College of Pharmacy, The Tamilnadu Dr. M.G.R.Medical University, Sholinganallur, Chennai119.*

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*Address for Correspondence:

SUNDHARARAJAN Ranganathan, Professor and Principal, Mohamed Sathak AJ College of Pharmacy, The Tamilnadu Dr. M.G.R.Medical University, Sholinganallur, Chennai 119.

Abstract

In this study an attempt was made to formulate cosmetic gel using *Maranta arundinacea* (arrowroot powder) Arrowroot contains flavonoids which is known for its anti-inflammatory properties, antibacterial properties from long time. It has earned a reputation as an elegant, lightweight, all-natural absorbent powder with added skin-nourishing, reduce oiliness, anti-inflammatory properties, anti-irritant properties and for treating wounds from historical times. The rhizome of the plant was processed to obtain arrowroot powder. The cosmetic gel was developed using two polymers carbopol 934 and sodium carboxy methyl cellulose (sodium CMC) in different ratios as gelling agents using dispersion method. The formulated gel was evaluated for various physicochemical factors like physical appearance, homogeneity, spread ability, pH and viscosity measurements. Cosmetic gel prepared using carbopol 934 by dispersion method in 1: 5 ratio showed better results in all parameters compared with sodium carboxy methyl cellulose. The best formulation F_3 was tested for its antimicrobial property against *Staphylococcus aureus* by comparing the zone of inhibition with the standard drug (Azithromycin) and blank gel. F_3 formulation showed a zone of inhibition of 15.2 mm above the minimum inhibitory concentration. Stability studies for 3 months gave promising results. Thus, cosmetic gel of arrow root with Carbopol 934 in the ratio of 1:5 was found to be ideal gel for acne treatment and skin rejuvenating purpose.

Keywords: Flavonoids, Rhizome, *Staphylococcus aureus*, Minimum inhibitory concentration, Zone of inhibition, Dispersion method.

INTRODUCTION

GELS:

The word ‘‘gel’’ is derived from ‘‘gelatine’ ’and both ‘‘gel’’ and ‘‘jelly’’ can be traced back to the Latin Gelu for ‘‘frost’’ and gelare, meaning ‘‘freeze’’ or ‘‘congeal’’[1]. The USP defines gels (sometimes called jellies) as semisolid systems comprising of either suspension made up of small inorganic particles, or large organic molecules interpenetrated by a liquid[1]. Gels are transparent semisolid preparation meant for external application on the skin or mucous membrane.[2] Gels can be formulated by fusion method, cold method or dispersion method.[3]

ARROWROOT (*Maranta arundinacea*):

Maranta arundinacea belonging to the family *Marantaceae*, is a monocot plant with vegetative propagation. The name arrowroot is due to the arrow-like appearance of the rhizome roots. *Maranta arundinacea,* Arrowroot is a perpetual plant with a height of 90–150 cm with white compound flowers, big green leaves with a length of 10–20 cm, and white fleshy cylindrical rhizomes with 2.5–3 cm width and 20–40 cm length. Their rhizomes either are found in a bunch of two to three or single. It has a cluster of long, slender stems that bears alternate, long lanceolate leaves. The fibrous, fusiform, fleshy rhizomes are abundant in starch. It is widespread in tropical countries like India, Sri Lanka, Indonesia, Philippines, Australia, and West Indies. In India, it can be found in Uttar Pradesh, Orissa Bihar, West Bengal, Assam, and Kerala.[4] The plant is shown in figure 1

Figure 1: Arrow root Plant (*Maranta arundinacea.linn*)

It also has various pharmacological activities like antidiarrheal activity, antioxidant, immune stimulatory, anti- ulcerogenic, anti-inflammatory and anti-microbial activity.[4] Apart from this arrowroot being an elegant, lightweight, all-natural absorbent powder that also possesses skin-nourishing and anti-irritant properties. It is widely useful in cosmetic preparations. Due to its brightening, mattifying, and skin- soothing effect which are suitable for oily, acne- prone, and sensitive skin types it is used in preparations of creams and lotions. It gives a light, soft, silky finish to the skin and produces a cooling, drying, and freshening sensation. It also finds its applications in deodorizing body powders for its ability to absorb sweat and moisture. It has earned reputation as an elegant, lightweight, naturally absorbing powder with added skin- nourishing, reduce oiliness, anti- inflammatory properties, anti-irritant properties and for the treatment of wounds since historical times. It contains minerals and vitamins such as zinc, iron, potassium, and vitamin B_6, and it is known to provide a relief from skin irritations including acne, skin sores, and rashes. It is suitable for all skin types and is especially gentle on sensitive skin, making it ideal for baby and elderly skin care products [5]. The main active constituent present is starch and flavonoids [4, 6]. The rhizomes are shown in figure no 2

Figure 2: Rhizomes of arrowroot (*Maranta arundinacea)*

Indian herbs and its significance are popular worldwide. Since herbal remedies are in demand and widely accepted globally due to their low cost and less side effects, the cosmetic gel formulated using *Maranta arundinacea* could give better results against acne. This could be a skin nourishing and rejuvenating cosmetic gel and could be more beneficial. Here an attempt was made to formulate and evaluate cosmetic gel using *Maranta arundinacea* with different gelling agents like carbopol 934 and sodium carboxy methylcellulose in different ratios. The formulation was evaluated for various parameters.

METHODOLOGY:

Materials and Methods

Identification of plant and authenticity:

On the basis of morphological features of the plant *Maranta arundinacea* (arrowroot) from the family *Marantaceae,* was collected from Kottayam, Kerala. The plant was authenticated by the post graduate department of botany, THE NEW COLLEGE, Chennai. Sodium carboxy methyl cellulose, glycerine, triethanolamine were purchased from Sigma – Aldrich and Merck. Carbopol 934 from Loba Chemie. Pvt ltd, Mumbai. All chemicals were of analytical grade.

Processing of rhizome of *Maranta arundinacea* to extract arrow root starch:[7]

The rhizomes were collected, and the skin was peeled. It was cleaned and washed to remove the soil, dirt and mud. The cleaned rhizomes were ground to get a thick pulp which was washed multiple times to remove the bitterness. Repeated cleaning and decantation with clean water results in sedimentation of starch. The sediment was collected and dried in oven at 60 ° C in hot air oven for air circulation to obtain the final starch product (arrowroot powder). The processing is shown stepwise in figure 3:

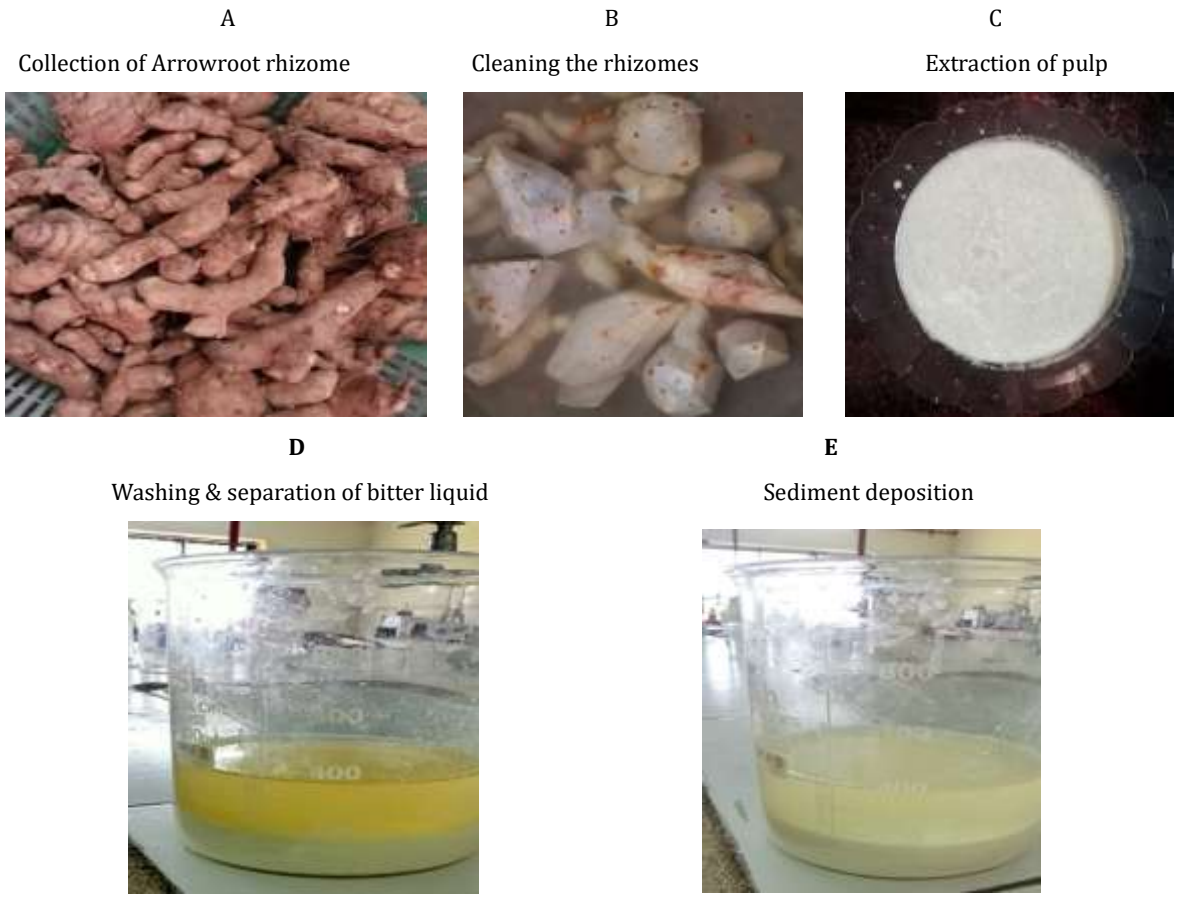

Figure 3: Processing of *Maranta arundinacea* rhizome to extract arrowroot starch

Formulation of cosmetic gel: [8]

It was prepared by dispersion method. The gelling agent was dispersed in 50ml of distilled water and mixed by continuous stirring using a mechanical stirrer at 800rpm for 1 hour. Glycerine (1ml) was added to the mixture with continuous stirring until a transparent gel was formed and was set aside for 4 hours. The arrowroot (*Maranta arundinacea*) powder was incorporated into the gel base and mixed continuously for uniformity. Triethanolamine was added to adjust the pH of the gel. Methyl paraben as a preservative and few drops of rose oil was added. It was mixed continuously to form a homogeneous gel. The composition of the formulation is shown in table no 1. The figure 4 shows the formulated cosmetic gel using carbopol 934.

Table No 1: Composition of cosmetic gel of *Maranta arundinacea* linn.

INGREDIENTS	F1	F2	F3	F4	F5	F6
Arrowroot powder(g)	1	1	1	1	1	1
Carbopol 934(g)	1	3	5	-	-	-
Sodium carboxy methyl cellulose(g)	-	-	-	1	3	5
Methyl paraben(mg)	1	1	1	1	1	1
Glycerine (ml)	1	1	1	1	1	1
Rose water (ml)	3	3	3	3	3	3
Triethanolamine(ml)	0.5	0.5	0.5	0.5	0.5	0.5
Distilled water (ml)	20	20	20	20	20	20

Figure 4: *Maranta arundinacea* cosmetic gel formulated with Carbopol 934.

EVALUATION TEST [9-11]

The prepared gel was evaluated for various parameters

Physical appearance:

The prepared gel formulations containing *Maranta arundinacea* were evaluated visually.

Homogeneity:

After the gels have been set in the container, it was tested for homogeneity by visual inspection. They were tested for their appearance, grittiness and presence of any aggregates.

Spreadability:

The spreadability of the formulated gels was determined by measuring the diameter of 1g gel between the horizontal plates (20 x 20 cm^2) after 1 minute. The standardized weight tied on the upper plate was 25g. It can be calculated using the formula,

$$S = M \times L / T$$

where S = spreadability coefficient; M = Standard weight tied on the plate; L = Length of the plate; T = time period taken to separate the plates.

Measurement of viscosity:

A Brookfield viscometer DV-I, with a concentric cylinder spindle #29 was used to determine the viscosity of the different topical formulations. The spindle was rotated at 20 rpm values. The tests were carried out at 21° C. All measurements were made in triplicate.

Measurement of pH:

The pH of the formulated gels was determined using a digital pH meter. 1 gm of gel was dissolved in 100 ml distilled water and kept aside for two hours. The pH of each formulation was measured in triplicate and the mean values were calculated.

Anti-microbial test: [12-14]

ANTIBACTERIAL STUDY (PLATE HOLE DIFFUSION METHOD)

Antibacterial study (plate hole diffusion or agar well diffusion) assay was used to determine the growth inhibition of bacteria. Bacteria were maintained at 4°C on nutrient agar plate before use. Nutrient agar medium was prepared at 121°C and each universals containing 20ml was poured. The universals with the broth were inoculated and incubated at 37°C for 24 hours. The nutrient agar was poured into sterile universals. Each universal was inoculated with 0.2ml of bacteria, mixed well with the nutrient agar and poured into the sterile petri dishes and was allowed to solidify.

A well was prepared in the plates with the help of a cork-borer (6mm), two holes per plate were made into the set agar containing the bacterial culture. A total of 0.2 ml of Standard and blank in Dish 1 and sample (F_3) and blank in Dish 2 were poured into the wells. The plates were incubated overnight at 37°C. The result was obtained by measuring the zone diameter. The result was compared with the standard antibiotic drug Azithromycin (1000 g/ml).

Stability test: [15]

Stability studies were done to assess the drug and formulation stability. It was carried out on the most satisfactory formulation (F3 - Formulation). The formulation was stored in a well closed stoppered glass container and kept at 5±3°C, 30±2°C for 3 months. At the end of each month, the samples were analysed for the appearance, colour, pH, viscosity and antimicrobial study.

RESULTS AND DISCUSSIONS

Extraction of Arrow root powder and preparation of gel:

The arrow root powder was obtained from the rhizomes of *Maranta arundinacea* Linn. After peeling of the skin followed by grinding the tubers, repeated washing and decantation was carried out to produce product. The obtained powder was white in colour. The gel was prepared by dispersion method using gelling agents like carbopol 934 and sodium carboxy methyl cellulose in various ratios of (1:1, 1:3 and 1:5).

Evaluation of gel;

The prepared gels were evaluated based on various parameters and the results were satisfactory.

Physical appearance and Homogeneity:

After visual inspection it was found that the F_3 formulation shows better appearance and homogeneity.

Spreadability test:

Spreadability of semisolid formulations refers to the ability of a cream or gel to evenly spread on the skin. It plays an important role in the administration of a standard dose of a medicated formulation to the skin and the efficacy of a topical therapy. Table 2 shows the spreading values (in $gm.cm^{-1}/sec$), that is, diameters observed for the formulations, after one minute. The values refer to the extent to which the formulations readily spread on the application surface by applying a small amount of shear. Results indicated that our gels had comparable spreadability.

Measurement of pH:

The pH of the gels was measured using a pH meter and ranges between 5.6 – 5.9.

Measurement of viscosity:

Viscosity of all the drug loaded gels were tested and the results are given in Table no. 2

The combined results of appearance, colour, texture, homogeneity, pH, viscosity are shown in Table no. 2.

Table 2: Evaluation of cosmetic gel of *Maranta arundinacea*

Parameters	F1	F2	F3	F4	F5	F6
Appearance	Opaque	Opaque	Glossy	Opaque	Opaque	Transparent & Glossy
Texture	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth
Colour	white	white	White	Yellowish-Brown	Light brown	Transparent brown
pH	5.7	5.6	5.6	5.8	5.9	5.9
Homogeneity	+++	++	+++	++	+++	+++
Spreadability (gm.cm $^{-1}$/sec)	7.3	6.58	5.83	7.12	6.83	6.62
Viscosity (cps)	10300	13700	17400	11200	13600	16900

Among the 6 formulations, F_3 and F_6 were found to be satisfactory which possess all the properties of a gel. F_3 formulation was considered as the best formulation due to its glossy appearance when compared with the F_6 formulation.

Antimicrobial study:

The antibacterial study was performed by measuring and comparing the diameter of zones of inhibition (in mm). The zone of inhibition can be defined as the clear region around the well that contains an antimicrobial agent. It is known that the larger the zone of inhibition, the more potent the antimicrobial agent.

The study was performed to compare the antimicrobial activity of the selected formulation to those of standard drug against *Staphylococcus aureus.* Azithromycin was used as the standard which was compared with the sample in the study. The presence of flavonoids could be the reason for the antimicrobial activity. The results of the study are displayed in Figure 5 and table no. 3. The results indicates that the formulation F_3 (Arrowroot: Carbopol gel of 1:5 ratio) shows antibacterial activity against *Staphylococcus aureus*.

Figure 5: Anti-Microbial activity of the best formulation with standard drug and blank

Table no. 3: Zone of inhibition of the formulation and standard drug

SAMPLES	ZONE OF INHIBITION (in mm)
Standard (Azithromycin)	22.75
Sample (F3)	17.20

Stability test:

The formulation was stored at different conditions of temperature in a glass container as per ICH guidelines for a period of 3 months. It was tested for various parameters like physical appearance, viscosity, colour, pH, texture and antimicrobial activity. The results are shown in Table 4

Table 4: Stability testing of cosmetic gel of Maranta arundinacea

Storage condition	Time period			Parameters			
		Appearance	Viscosity (cps)	Texture	Colour	pH	Zone of inhibition (mm)
5±3°C	**Day 1**	Glossy	17400	Smooth	White	5.6	17.20
	After 30 days	Glossy	17400	Smooth	White	5.6	17.20
	After 60 days	Glossy	17402	Smooth	White	5.6	17.18
	After 90 days	Glossy	17402	Smooth	White	5.6	17.18
30±2°C	**Day 1**	Glossy	17400	Smooth	White	5.6	17.20
	After 30 days	Glossy	17397	Smooth	White	5.6	17.20
	After 60 days	Glossy	17395	Smooth	White	5.6	17.21
	After 90 days	Glossy	17392	Smooth	White	5.6	17.21

CONCLUSION:

Natural and organic cosmetics are greatly influencing and changing the cosmetics panorama. People tend to prefer natural cosmetics over chemical cosmetics in order to avoid the consequences and side effects caused due to the harsh chemicals. Knowing the present-day pollution and weather changes causes a lot of skin conditions like Acne, pimples, milia, eczema, etc., an attempt was made to formulate and evaluate a cosmetic gel .The cosmetic gel formulated using arrowroot powder with Carbopol 934 in 1:5 ratio showed to give better homogeneity, appearance, spreadability and the best formulation **(F_3)** was tested for its antimicrobial activity against *Staphylococcus aureus* related to skin infection with the standard drug (Azithromycin). The zone of inhibition was compared to the standard the drug and was above the minimum inhibitory concentration. Therefore, could be an ideal cosmetic gel for treating acne and skin rejuvenation purpose.

FUTURE SCOPE:

Future studies can be done for quantitative analysis of flavonoids and starch, by testing the *invitro* permeability coefficient on animal skin and by testing *in vitro* release of drug. Clinical studies could be undertaken in future to check irritancy, redness upon the application on the skin.

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CONFLICT OF INTEREST:

Authors declare that they have no conflict of interest.

REFERENCES:

1. Rathod HJ, Mehta DP, A Review on Pharmaceutical Gel, Acta Scientifica International Journal of pharmaceutical sciences, 2015; 1(1):1-10.

2. Alam S, Sahoo J, Sharma S, Pharmaceutics -1, Third edition, Pune: Nirali Prakashan; 2019; 5.16 - 5.17

3. Badola A, Goyal M, Baluni S, Gels and jellies a recent technology in semisolids: A Review, World journal of pharmaceutical research, 2018; 1(1):11-20

4. Firoskhan N, Muthuswamy R, Review on Maranta arundinacea L. (Marantacea), International Journal of Pharmacognosy and Pharmaceutical Research, 2021; 3: 18-26

5. All about Arrowroot Powder: A natural, nourishing talc substitute; Available from: https://www.newdirectionsaromatics.com/blog/products/all-about-arrowroot-powder-a-natural nourishing-talc-substitute.html; Accessed on March 5,2023

6. Tarique. J, Sapuan S.M, Khalina. A , Sherwani. S.F.K , Yusuf J, Ilyas R.A, Recent developments in sustainable arrowroot (Maranta arundinacea Linn) starch biopolymers , fibres, biopolymer composites and their potential industrial applications: A review, Journal of Materials Research and Technology, 2021;13:1191-1219. https://doi.org/10.1016/j.jmrt.2021.05.047

7. Nogueira GF, Fakhouri FM, Oliveira RAD, Extraction and characterization of arrowroot (Maranta arundinaceae L.) starch and its application in edible films Carbohydrate Polymers, 2018; 186:64-72. https://doi.org/10.1016/j.carbpol.2018.01.024

8. B. Niyaz Basha, Kalyani Prakasam, Divakar Goli, Formulation and evaluation of gel containing fluconazole-Antifungal Agent, International Journal of Drug Development & amp; Research, 2011; 3(4):234-255.

9. Aiyalu R, Govindarajan A, Ramasamy A, Formulation and evaluation of topical herbal gel for the treatment of arthritis in animal model , Brazilian Journal of Pharmaceutical Sciences, 2016 ;52(3):494-495 https://doi.org/10.1590/s1984-82502016000300015

10. Ghorpade V, Mali K, Dias R, Karande P, Carbopol and sodium carboxy methyl cellulose-based methyl sulfonyl methane gels for treatment of Osteoarthritis: invitro and in-vivo Evaluation, Indian Journal of pharmaceutical Education and Research, 2012; 46(3):1-9.

11. Mei X. Chen, Kenneth S. Alexander, and Gabriella Baki, Formulation and evaluation of antibacterial creams and gels containing metal ions for topical application, Journal of Pharmaceutics, 2016; 4-7. https://doi.org/10.1155/2016/5754349

12. Balouiri M, Sadiki M, Ibnsouda SK, Methods for invitro evaluating antimicrobial activity; a review, Journal of Pharmaceutical Analysis, 2016; 6:7179 https://doi.org/10.1016/j.jpha.2015.11.005

13. Palombo EA, Semple SJ, Antibacterial activity of traditional australian medicinal plants, Journal of ethnopharmacology, 2001; 77(2-3):151-157. https://doi.org/10.1016/S0378-8741(01)00290-2

14. Kinsley JD, Tirkey PM, Chauhan R, Abraham Jyanthi, Evaluation of antimicrobial activity of Ficus racemosa Linn leaves extract, International Journal of Pharmacy and Technonolgy, 2014; 6 (1):6310-6317.

15. Kaur D, Raina A, Singh N, Formulation and evaluation of carbopol 940 based glibenclamide transdermal gel, International Journal of Pharmacy and Pharmaceutical Sciences, 2014;6(8):436.