

## Original Research Article

# Effect of Turmeric (*Curcuma longa* Zingiberaceae) Extract Cream on Human Skin Sebum Secretion

Shahiq uz Zaman\* and Naveed Akhtar

Department of Pharmacy, Faculty of Pharmacy and Alternative Medicine, The Islamia University of Bahawalpur, 63100 Pakistan

\*For correspondence: **Email:** shahiq75@yahoo.com; **Tel:** 0092-333-3854488

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## Abstract

**Purpose:** To evaluate the effect of a w/o cream of turmeric (*Curcuma longa* Zingiberaceae) extract on skin sebum secretion in human volunteers.

**Methods:** Two w/o cream formulations were prepared - one contained 5% extract prepared from the rhizomes of the plant, turmeric, and the second was similar except that it did not contain the extract and served as control. The antioxidant activity of the extract was determined by using the DPPH method. Evaluation of the effect of the creams on skin sebum secretion was conducted with the aid of a sebumeter. Initial sebum measurements on the face of thirteen human volunteers were taken with the sebumeter prior to application of cream, and then fortnightly after twice daily application of cream (on the right and left cheeks for control and extract creams, respectively) over a period of three months.

**Results:** Significant increase ( $p < 0.05$ ) in the sebum values was observed from the 6<sup>th</sup> week onwards after control cream application. Maximum increase of 6.2% was observed on the 10<sup>th</sup> week of the study. On the other hand, following extract cream application, a significant decrease ( $p < 0.05$ ) in sebum secretion occurred from the 4<sup>th</sup> week onwards, reaching a maximum of 24.8% at the end of the study period. The antioxidant activity of the extract was 88.5% of the standard.

**Conclusion:** The study demonstrates that the extract obtained from the rhizomes of turmeric plant can be used in skin preparations to regulate excessive sebum secretion in persons suffering from acne and related problems.

**Keywords:** Turmeric, Sebum, *Curcuma longa*, Sebumeter, Skin, Acne

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## INTRODUCTION

*Curcuma longa* (turmeric) is a plant in the Zingiberaceae family which is a native of south Asian region [1]. The rhizomes of *Curcuma longa* contain curcuminoids which are used as a food additive for the promotion of health as well as for the cure of various types of diseases [2]. Curcumin and other curcuminoids present in *Curcuma longa* possess a variety of physiological and pharmacological activities [3]. The use of turmeric extract as a cosmetic or skin

care product as both topical and oral preparations has been reported [4]. It is claimed to be effective in treating skin-aging induced by sun exposure, increased thickness and reduction in elasticity of skin, skin injury and other problems. Little experimental data exist to support these claims [4]. Thus, there is a need to evaluate the beneficial effects or otherwise of this plant.

Sebum is an important secretion of the body originating from sebaceous glands. Of the total

lipids present in skin, the contribution of sebum is about 95%. The composition of sebum at synthesis is different from that when it reaches the surface of the skin, where it is composed of triglycerides, free fatty acids, wax, squalene, sterols and glycopospholipids. In humans sebum plays important role in protecting skin from microorganisms and harmful chemicals. It also potentiates the emollient function of skin by retaining water [5]. Excess production of sebum, on the other hand, results in oily skin which may lead to acne and seborrheic dermatitis [6]. Acne is considered an adolescent disease which affects about 80% of the population aged between 11 and 30 years [7].

The present study was aimed to formulate a w/o cream containing extract of turmeric and evaluate its effect on sebum secretion in human volunteers.

## EXPERIMENTAL

### Plant material

The plant was collected from the fields of Pattoki, a city near Lahore, Pakistan in the month of March. The plant was identified by Dr. Qaiser Jabeen of the Department of Pharmacy, Faculty of Pharmacy and Alternative Medicine, the Islamia University of Bahawalpur, Pakistan. The specimen was deposited in the herbarium of Department of Pharmacy, the Islamia University Bahawalpur Pakistan, with voucher no. CL-RM-03-10-22.

### Other materials, reagents and equipment

Abil<sup>®</sup>EM90 which was used as an emulsifier was purchased from the Franken Chemicals Germany. Liquid paraffin oil, which was used as the oil phase of the cream, was purchased from the Merck Germany. Methanol (95%), the extraction solvent for the plant material, was purchased from BDH England. Distilled water was used as the aqueous phase of the cream.

### Preparation of turmeric extract

The rhizomes of *Curcuma longa* (turmeric) were shade-dried and ground into powder, and 200 g extracted with 1 L of methanol according to the method of Zaman *et al* [8]. A rotary evaporator (Rotavapor, Eyela Corporation Limited, Japan) was used to concentrate the extract and the extract stored at 4 °C in a refrigerator.

### Evaluation of antioxidant property of turmeric extract

The antioxidant activity of the extract was determined by using DPPH (1, 1-diphenyl-2-picrylhydrazyl) method [9]. The plant extract (5 µl) was taken in a 96-well plate in triplicate and the volume was made up to 100 µl by the addition of DPPH. The contents were mixed and incubated at 37 °C for a period of 30 min. The absorbance was then measured at 517 nm. Ascorbic acid (5 µl) was used as standard and DPPH was added to make up the volume up to 100 µl. The absorbance was also measured at 517 nm.

### Formulation of test creams

To assess the effects of the plant extract on sebum secretion, creams of w/o type were formulated. Two types of cream were formulated by the method of Zaman *et al* [8]. The aqueous and oil phases were taken in beakers and heated to 75 °C over a water bath. The oil phase of the first type comprised of paraffin oil (16%) and Abil<sup>®</sup>EM90 (3%) while the aqueous phase was composed of 5% extract and distilled water in sufficient quantity to make up to volume. Dropwise addition of the aqueous phase to the oil phase was done with constant stirring at 2000 rpm in a homogenizer (Euro-Star, IKA D 230, Germany) for a period of 15 min. The homogenizer speed was then reduced to 1000 rpm and homogenization was continued for another 5 min. The speed was further reduced to 500 rpm and the homogenization extended for 5 min. Control cream was similarly formulated except that no extract was incorporated.

### Organoleptic properties

Changes in organoleptic properties of the creams were evaluated by visual inspection and the properties evaluated included the color of the creams, liquefaction and phase separation. These were evaluated over a period of 2 months at specific time intervals.

### Physical evaluation of creams

Physical tests including pH, electrical conductivity, and centrifugation test, were carried out on the creams over a period of two months at specific time intervals. The pH of the creams was determined by a pH meter (WTW pH-197i, Germany). Electrical conductivity of the creams was determined by a conductivity meter (WTW COND-197i, Germany). Centrifugation was performed by using a centrifuge (Hettich EBA 20, Germany). The centrifuge was operated at 5000

rpm for 10 min, after which the contents were observed for phase separation.

### Stability studies

Stability studies on the creams were conducted over a period of two months at four different conditions: (a) At  $4 \pm 1$  °C in a refrigerator (Dawlance Company, Pakistan), (b) at  $25 \pm 1$  °C in an incubator (Sanyo MIR-153, Japan), (c) at  $40 \pm 1$  °C in an incubator (Sanyo MIR-162, Japan) and (d) at  $40 \pm 1$  °C with relative humidity maintained at 75%, in an incubator (Sanyo MIR-162, Japan). The study included visual examination to evaluate any change in the organoleptic properties of the creams, and various physical tests to assess the stability of the creams at various storage conditions.

### Ethical standards

Approval (ref no. 551/Acad) for the human studies was obtained from the Pharmacy Research Ethics Committee (PREC), Faculty of Pharmacy and Alternative Medicine, The Islamia University, Bahawalpur. The guidelines followed were in accordance with the principles set in Declaration of Helsinki [10]. Informed consent was given in writing by the volunteers.

### Study design

The total number of volunteers selected for this study was thirteen and they were all male in the age range of 20 to 40 years. They were examined by a dermatologist to ascertain that none of them was suffering from any serious skin disease or any other damage to the skin, especially on the cheeks and forearms. A volunteer protocol stating the terms and conditions of the study was provided to all the volunteers before the study. The volunteers had to sign the consent form to show their agreement with the terms and conditions of the study, and were blind to the contents of the creams. Every volunteer was given the two cream types - the extract cream and control. To exclude hypersensitive volunteers, a patch test was performed on all the volunteers before the commencement of the study. The body area selected for the patch test was the forearm and the test duration was 48 h. The formulation was applied on the patch made on the left forearm and the base was applied on the patch made on the right forearm, and after 48 h, the patch was removed. The degree of erythema before and after the application of the patch was measured with the aid of Mexameter (model MPA 5, Courage and Khazaka, Germany). If a volunteer felt irritation or itching during the patch test or if

there was a significant increase in erythema, the volunteer was not included in the study. All the volunteers passed the patch test in the present study as no significant rise in erythema values was observed and hence all of them participated in the study.

Facial sebum measurements of the volunteers were taken with the aid of Sebumeter (model MPA 5, Courage and Khazaka, Germany). The measurements were taken in the laboratory at  $25 \pm 1$  °C and relative humidity of  $40 \pm 2\%$ . At the start of the study, i.e., before cream application, sebum measurements on both the right and left cheeks of the volunteers were taken. Both creams, extract cream and control cream, were then given to each volunteer, and detailed instructions on the proper use of the creams were given to them. The volunteers were instructed to apply the creams twice daily, the extract cream on the left cheek and control on the right cheek for a period of 3 months. The volunteers came back to the laboratory every fortnight for the measurement of facial skin sebum measurement.

### Statistical analysis

Mean  $\pm$  standard error of mean (SEM) of the data were computed. The analysis of the data was made using SPSS, version 17.0. The statistical tools used were two-way ANOVA and paired sample t-test. The level of significance applied was  $p < 0.05\%$ .

## RESULTS

### Antioxidant activity

The antioxidant or free radical scavenging activity of the extract was determined by using the DPPH method and was found to be 88.5% of the standard.

### Stability of the creams

During the two-month study period, no change in the color of the creams was seen, their pH was within the range of normal skin pH (4 - 6), no electrical conductivity was detected, but slight phase separation and liquefaction was observed on week 8 for the extract cream and on week 7 for control at  $40$  °C / 75% RH.

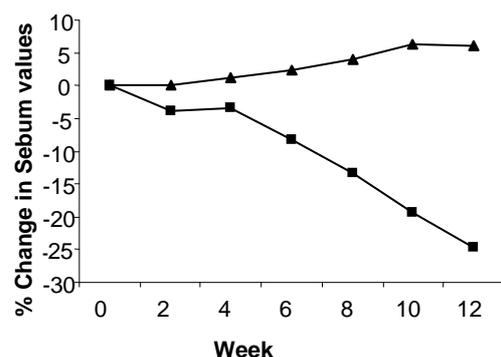
Regarding the effects produced on the sebum secretion in human volunteers, it was found that the base increased the sebum values on the other hand the formulation decreased the sebum values (Table 1). In the case of the base

**Table 1:** Sebum values for volunteers before and after cream application to cheeks.

Cream	Mean skin sebum values ( $\pm$ SEM)						
	Week 0	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12
Control	139.0 $\pm$ 11.9	139.3 $\pm$ 11.9	140.4 $\pm$ 11.7	142.3 $\pm$ 12.1	144.2 $\pm$ 11.9	147.2 $\pm$ 12.0	147.2 $\pm$ 12.1
Extract	141.4 $\pm$ 10.8	136.6 $\pm$ 12.1	137.0 $\pm$ 11.6	130.1 $\pm$ 11.2	122.0 $\pm$ 9.5	112.5 $\pm$ 7.2	104.7 $\pm$ 6.2

(control) the increase was insignificant in the 2<sup>nd</sup> and 4<sup>th</sup> week while it was significant on 6<sup>th</sup> week and onwards ( $p < 0.05$ ). The increase in sebum values produced by the base with time was significant ( $p = 0.000$ ). A maximum increase of 6.20% was observed at the 10<sup>th</sup> week of the study period (Fig 1).

For the extract formulation, a regular decrease in sebum values was observed throughout the study period of three months. The decrease was insignificant in the 2<sup>nd</sup> week of study but significant decrease was observed ( $p < 0.05$ ) from 4<sup>th</sup> week to onwards (Table 1). The highest decrease of 24.76% was observed at the end of the study period ( $p = 0.000$ ), as shown in Figure 1.



**Fig 1:** Changes in sebum values of volunteers over time following application of control (▲) and extract cream (■)

## DISCUSSION

Since no color change was observed, pH remained within normal physiological range of skin pH, and liquefaction and phase separation was negligible during stability studies therefore the formulation can be considered stable [11].

The increase in sebum secretion after application of control cream may be due to the oily nature of the cream, as paraffin oil was used in the formulation which itself was oily in nature and can raise sebum values [12]. Previous studies have reported that the production of sebum is stimulated by androgens, including testosterone. This hormone is metabolized to dihydrotestosterone in the skin by the enzyme, 5 $\alpha$ -reductase, and the former is the more potent form of testosterone. Dihydrotestosterone causes enlargement of sebaceous glands which results

in increased secretion of sebum. It has been claimed that by applying type 1 5 $\alpha$ -reductase inhibitors alone or in combination with type 2 5 $\alpha$ -reductase inhibitors, skin sebum levels may be lowered [6]. Some botanicals such as Saw palmetto, *Sesamum indicum*, *Argania spinosa* and *Capparis deciduas*, are used to regulate excess production of sebum [6,8]. The unsaturated fatty acids ( $\alpha$ -linolenic acid,  $\gamma$ -linolenic acid, linoleic acid and oleic acid), the saturated fatty acids (palmitic acid and stearic acid) and phytosterols (especially  $\beta$ -sitosterol and stigmasterol) are considered to be responsible for these effects [6].

Various fatty acids and steroids have been reported to be present in turmeric extracts including palmitic acid, oleic acid, linoleic acid, linolenic acid, palmitoleic acid, stearic acid and myristic acid,  $\beta$ -sitosterol and stigmasterol [13,14]. The observed decrease in sebum values of the skin following the application of the extract cream may be due to the turmeric extract in the formulation. This is buttressed by the fact that the control cream, which did not contain the plant extract, increased sebum levels.

## CONCLUSION

This study shows that along with other applications of turmeric for medicinal purposes to improve skin conditions, a w/o cream of the extract can potentially be used to regulate sebum production in human skin. Persons with excessively oily skin or are suffering from acne will greatly benefit from this property. Further studies to develop a suitable topical application of the extract are, however, required.

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