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## Makeup ingredients (lactic acid, getyl alcohol, and citric acid) attract mosquitoes

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### Abstract

Mosquitoes are emerging problems in different parts of the world, especially in Asia. They are not only annoying at night but few types of those mosquito species are also involved in spreading different types of diseases. Make up products are widely used all over the world. This study was designed to measure the effects of makeup products on mosquitoes. White rats were used in this study. Few make up products like Lactic acid, Getyl alcohol, and Citric acid were applied to skin of rats. Mosquitoes were attracted towards these products (Spp1 F value 10.5997; Spp2 F value 23.3425 and Spp3 F value 9.3514). Output of this study provided clear message to the makeup product users that use of makeup product having these ingredients shall be avoided especially in open areas because that attracts mosquitoes. Furthermore, this study may also trigger efforts of commercial companies for alternate makeup components.

**Keywords:** Attraction effects, Makeup ingredients, *Anopheles*, *Aedes*, *Culex*

### 1. Introduction

About 2500 species and 41 genera of mosquitoes belong to order Diptera and family Culicidae are present all over the world [3] and medically imperative genera of mosquitoes are *Aedes*, *Culex* and *Anopheles* [3]. Mosquitoes are present around the world (except Polar Regions) and are 0.3 cm - 0.6 cm long, soft bodied insects [3]. They normally breed in watery places where stagnant water is present. Mosquitoes are the most important blood suckers that suck blood from animals, birds and human beings. Mosquitoes are world's most annoying arthropod because of their blood sucking and disease transmitting diseases viz dengue, filiriasis, viral encephalitis, malaria and many other lethal diseases [10, 15, 19]. Due to hematophagy, mosquitoes are the important vector of disease transmission in world-wide [13]. Most important species of mosquitoes which transmit numerous diseases particularly and preferably in human being, are the *Anopheles gambiae* and *Aedes aegypti* [23]. Female of *Ae. aegypti* mostly suck blood from humans [18]. Female mosquitoes don't feed on any host, it only land and start feeding on preferred host having specific odour [12]. All the humans are not uniformly attracted by the mosquitoes [11]. Difference in attractiveness of host depends on several factors such as body odour, temperature visual cues and moisture. However the body odour plays a significant role in host selection [7]. Yellow fever mosquito is the main species of mosquito that is frequently attracted towards the host odour but it is not clear why mosquitoes are attracted towards the human skin odour. Lactic acid is one of the most important components of sweat that attracts the yellow fever mosquitoes. Geier in 1996 described that only lactic acid is the weak attractant but when it combines with other components then become a strong attractant [9]. Previous studies indicate that in *Ae. aegypti*, there may be relationship present between amount of Lactic acid on skin and mosquito attractiveness [2].

Host selection by the mosquitoes is principally based on the ability of mosquito to differentiate the host on the basis of specific odour [16]. *Ae. aegypti* is the model organism in mosquitoes as it is the most studied species and transmits yellow fever and dengue fever to humans. Lactic acid and Carbon dioxide play vital role in the host finding. Lactic acid is also present in the sweat of human being while carbon dioxide is exhaled during breathing [1]. Geier in 1996 stated that other than Lactic acid non identified components of human odour play significant role in attracting mosquitoes [8].

The main objective of this research work was to check the effect of different make up ingredients (lactic acid, getyl alcohol and citric acid) which are commonly used in makeup products on three important mosquito species (*Culex*, *Aedes* and *Anopheles*).

## 2. Materials and method

The experiment was conducted at University College of Agriculture, University of Sargodha, from April to September 2015. For the rearing of mosquitoes a box with dimension of 2 by 2 feet made up of glass having net on both sides for ventilation. Other somewhat large box for rat rearing was placed with dimensions of three feet in length and one feet width. The rat rearing box was made up of steel wires. Mosquito species were collected at larval stages from different areas of the city. Collection of mosquito larvae was also done by placing larvae traps in different selected location and identification of the larvae of three important species was done by using keys [17, 20-21]. Collected larvae were placed in glass jars. The Jars were then shifted into a large glass box. Crushed fish feed was provided to the mosquitoes larvae as their diet. After 3-5 days adults emerged out from the pupae. White rats were used for the blood feeding of female mosquitoes. For feeding purpose white rats were placed in glass box having mosquitoes for about half hour after the starvation period of one day.

Seven treatments containing three makeup ingredients viz. lactic acid, getyl alcohol and citric acid and four combinations of these ingredients (lactic acid + citric acid, Lactic acid + getyl alcohol, Citric acid + getyl alcohol and Lactic acid + Citric acid + getyl alcohol) and one treatment used as control (water treated rats were used as control). Each treatment was replicated thrice. Twenty one boxes were used for this experiment. Replications were performed one by one as 2<sup>nd</sup> replication was started after completing the 1<sup>st</sup> replication and 3<sup>rd</sup> replication was done after 2<sup>nd</sup>. Twenty five female mosquitoes were placed in each box for all treatments. Firstly *Aedes aegypti* was placed and checked. Blood feeding was stopped before 24 hrs of the experiment. Makeup ingredients were applied on the tail rats. These rats were placed in the boxes. All the rats were treated with different makeup ingredients one by one; one control treatment was also placed simultaneously in the boxes to check the difference. Data was recorded after 5, 10, 15, 20, 25 and 30 minutes to check the attraction effects of makeup ingredients. After completion the experiment on *Aedes* spp the same experiment was repeated for next two mosquito species. After 30 mints rats were removed from the cages and placed them in the rat rearing box containing special diet for recovery. After 2 days of rest, *Anopheles gambiae* of mosquito was released in the cages in the same manner and the same number. Rats were also placed in the cages after treating with the same treatment of makeup ingredients mentioned above. Total numbers of *Anopheles gambiae* mosquitoes were counted feeding on the rats. The same process was performed for *Culex quinquefasciatus*.

## 3. Result Discussion

### 3.1. Effects of make products on *Aedes aegypti*.

Collected data from each cage showed that *Aedes* mosquitoes were highly attracted towards the makeup ingredients. *Ae. aegypti* were highly attracted towards the ingredient combination Lactic acid + Citric acid + getyl alcohol (94.67±4.333). Second most attractive ingredient was the citric acid following by the Lactic acid + getyl alcohol (91±1) combination while the least attractive ingredient was the Lactic acid + Citric acid (88±6.50) as shown in fig. 1.

### 3.2. Effects of make products on *Anopheles gambiae*

After releasing the *An.* mosquitoes and white rats in the cages, 1<sup>st</sup> data was recorded after 5mints and all the data was recorded with the 5 minutes interval till 30 minutes. Collected data showed that *Anopheles gambiae* mosquito species was less attracted then *Ae. aegypti* towards the makeup products. Data shows that *An. gambiae* was highly attracted towards the lactic acid and followed by the lactic acid + citric acid + getyl alcohol combination (80.33±9.87) as shown in fig. 2. So any makeup products having lactic acid or combination of getyl alcohol are highly attractive for the *Anopheles*.

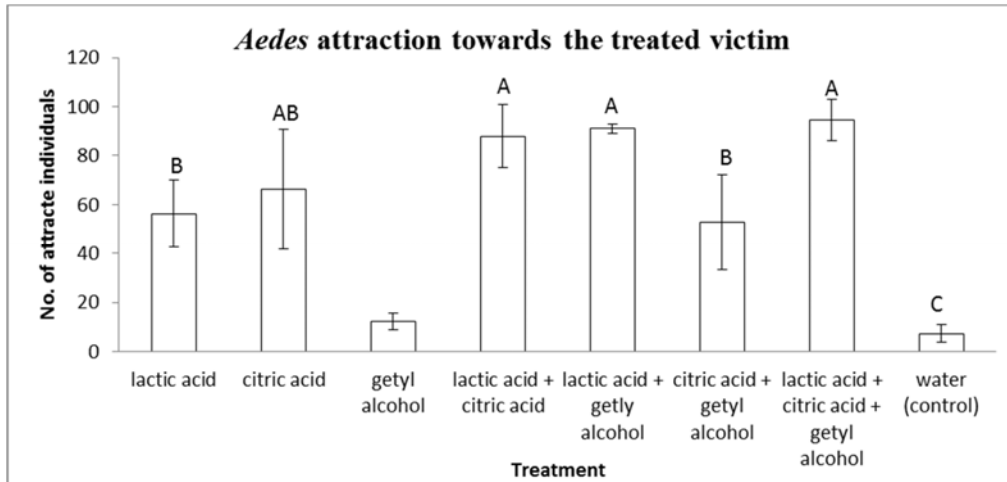
### 3.3. Effects of make products on *Culex quinquefasciatus*.

*Culex quinquefasciatus* showed least attraction towards the makeup ingredients fig. 3. It was attracted toward the getyl alcohol more than *Aedes*. As a *Culex* mosquitoes were least attracted towards the makeup products.

Medically important mosquito species shows positive results towards the ingredients. *Ae. aegypti* showed highly positive result against citric acid, Lactic acid + citric acid, Lactic acid + getyl alcohol and Lactic acid + Citric acid + getyl alcohol while it did not showed attraction towards the Lactic acid, Lactic acid act as repellent against *Ae. albopictus* [24]. In present study, three different makeup ingredients were tested against the three medically important mosquito species i.e. *Aedes*, *Anopheles* and *Culex*. Variability in data was recorded in all three species of the mosquitoes. *Aedes* mosquito showed more attraction as compared to rest of the species for four chemicals while *Anopheles* was somewhat less attracted towards the two chemical and the *Culex* was the least one in attraction towards the one chemical. In case of Citric acid, *Aedes* mosquito shows more attraction towards it while *Anopheles* was again less attracted towards the citric acid while *Culex* showed the least attraction behaviour. Combination of these three ingredients shows more attraction for the *Aedes* mosquito species it was the second most attractive for anopheles while *Culex* shows the least attraction towards the ingredients.

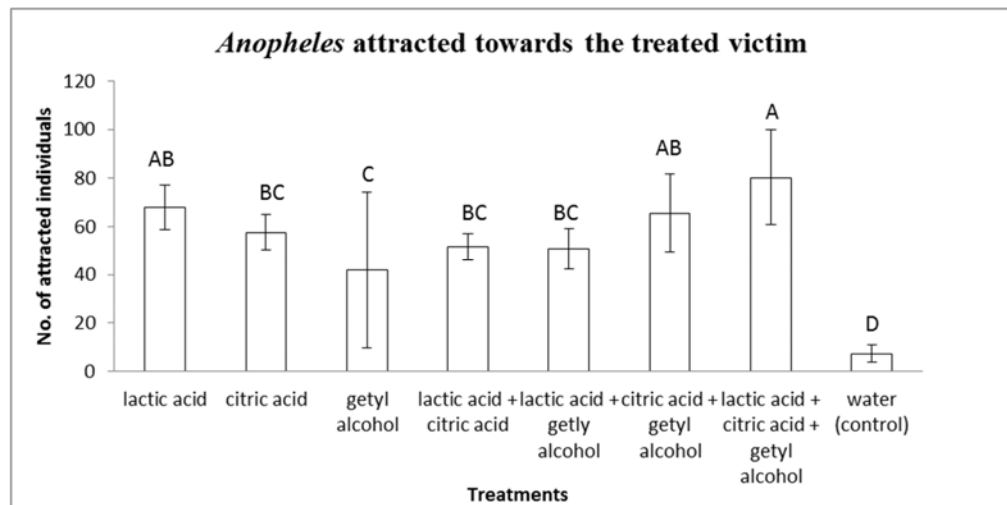
Chemical signals are very important for the host seeking mosquitoes. In human body the important gene for producing the body odours are Human Leukocytes antigen (HLA). Individuals carrying the Lactic acid and 2- methylbutanoic acid are highly attractive for mosquitoes [22]. Different chemicals are emitted by the human body which is attractive for female mosquitoes. Gr3 lack individuals of *Aedes* mosquitoes show no attraction towards the CO<sub>2</sub>, lactic acid and heat of the body [14]. Lactic acid sensitive receptors are present at the antennae of the female mosquitoes of *Ae. atropalpus* [4]. Females of *Culex pipiens* go to diapause conditions for about 30 days if antennae of female had not developed Lactic acid receptor but if developed it does not go to diapause [5]. Lactic acid and Orthophosphoric showed insecticidal properties against laboratory larvae of the *Ae. aegypti* [6]. Lactic acid showed relative repellence affect against *Ae. albopictus*. Lactic acid applied on the skin of human and mouse shows very low attraction than the control [24].

**3.3.1. *Aedes aegypti* attraction towards the treated victim**



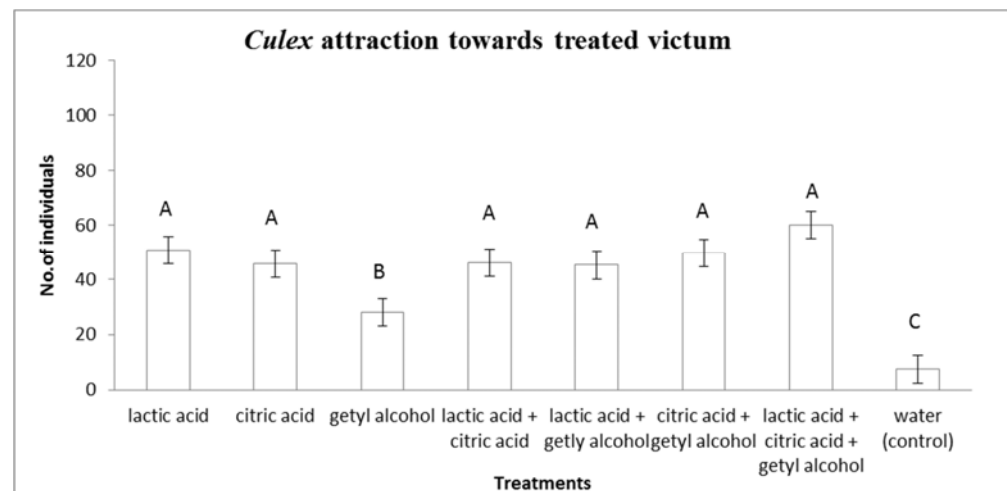
**Fig 1:** shows the attractant effect of makeup ingredients on *Aedes spp*

**3.3.2. *Anopheles gambiae* attraction towards the treated victim**



**Fig 2:** shows the attractant effect of makeup ingredients on *Anopheles spp.*

**3.3.3. *Culex quinquefasciatus* attraction towards the treated victim**



**Fig 3:** shows the attractant effect of makeup ingredient on *Culex spp.*

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