Analysis of tears - An in vitro study

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INTRODUCTION

Tears from each of the three categories include distinct molecules apart from specific proteins and oils. Although they all seem similar, the tears can be very distinct based on their purpose.[¹]

Tears consist of three layers as follows: The outer hydrophobic layer prevents the tears from evaporating. The oil called “meibum” is secreted by the meibomian glands.[²-⁵] A middle aqueous layer contains the salts, electrolytes, and nutrients (glucose and proteins) help in osmoregulation and prevents infection. Finally, the inner hydrophilic mucous layer keeps the tissue of the eye moisturized. The mucin is produced by goblet cells of the eye and gives coherence to the tear film.[⁶]

There is a thin film of tear present on the surface of the eye responsible for maintaining vision, nourishment, and lubrication. In case of any disturbance to this film, the person starts to experience irritation which will lead to tearing.[⁷]

Tears are produced by the tear glands present on the upper eyelids. The tears then flow into the eyes through very small tear ducts. Once used, the tears flow down through tiny holes into the back of your nose. An abnormal tear film can result in dry eyes which is detrimental to vision.[⁸] Tears glands are also called “lacrimal glands.” Tears (basal) are continuously secreted by accessory lacrimal glands while the reflex tears and psychic tears are produced by the main lacrimal glands.[⁹]

These tears are secreted for various purposes under various conditions. They can be broadly classified into three as follows: (1) Basal tears, (2) reflex tears, and (3) psychic tears. They are responsible for lubrication, protection, and pain relief, respectively.[¹⁰]

Basal Tears

These tears are always present in the eye, ensuring that the cornea is kept lubricated and nourished. The thin layer also smoothens the irregularities and creates a very even surface for optical quality. The film prevents the bacteria from adhering to the surface of the eye, while the salts and some antibiotic proteins in the tear film kill them.

Reflex Tears

These tears are secreted in response to a sudden external factor or stimulus causing irritation in the eye, for example, foreign particles such as dust and chemical substances such as onion vapors and tear gas. The principle of reflex tears is to produce excess

ABSTRACT

Introduction: Tears consist of a variety of biological substances in addition to salts. Since the structures observed through a microscope are mostly crystallized salt, the tear on drying results in unique formations depending on its composition which varies for different tears. Materials and Methods: The three types of tears namely basal, reflex and emotional or psychic were collected from each participant on glass slides. Tears were labeled, and crystallized patterns were observed under a microscope. Results: It was observed that all three tears exhibited distinct crystal structures, but remained almost similar in all six individuals. In other words, all basal tears looked the same, all reflex tears looked the same, and all psychic tears as well. Conclusion: Tears produced for various reasons under various circumstances have different compositions and hence form distinct patterns when allowed to crystallize.

KEY WORDS: Basal tears, Composition, Microscopic structure of tears, Psychic tears, Reflex tears
basal tears and wash out the factor causing discomfort in the eye.

**Psychic Tears**

Tears produced due to emotions are said to contain a totally different chemical composition. They have more proteins mainly lactoferrin, lysozyme, IgA, IgG, albumin, and various hormones that act as natural painkillers. Very strong emotions trigger the parasympathetic nerves of the autonomic system, hence the tear glands are activated.

One of the major components of tears is salts, mostly sodium chloride (NaCl) and potassium chloride (KCl). The salts are responsible for the different microscopic structures formed on drying of the tears. The concentration and composition of tears vary greatly according to its type. Therefore, this study aims to prove that tears produced under different conditions will look different under the microscope.

**MATERIALS AND METHOD**

**Collection of Tears**

People who volunteered participated in this study. The three types of tears namely basal, reflex and emotional or psychic were collected from each participant on glass slides. The basal tears are responsible for lubrication, so they were easily collected by asking the participants not to blink for a few minutes and collecting the tears that were produced due to drying up of their eyes. Reflex tears were collected when the participants were made to chop onions, and the vapor caused them to tear up. Finally, the psychic or emotional tears required each of the participants to tear up due to strong emotions, here the emotion used was sympathy and sadness. They were shown a series of extremely upsetting clips causing them to shed tears of grief.

**Drying the Tears**

Once the tears were collected, they were labeled and allowed to dry. No stain was added. The slides were left for more than an hour. Crystallized patterns could be observed on the glass slides.

**Observing Under the Microscope**

The slides with dried tears were placed under a microscope and observed under ×10 and ×40. Pictures were taken of the slides for comparison.

**RESULTS AND DISCUSSION**

The basal tears, reflex tears, and psychic tears look different under the microscope. They can easily be differentiated, whereas the tears of the same type looked similar even though they were collected from six different individuals.

In a project called “topography of tears,” photographer Rose-Lynn Fisher examined dried human tears under the microscope. She studied more than 100 tears collected from various people under various conditions. She found that each tear gave a different microscopic formation. The cause for this is proposed to be the varying compositions of different tears and their concentration of salts. However, another theory was suggested by the late Dr. Masaru Emoto, a Japanese researcher, who studied the effect of human consciousness on water and its crystalline structure. He demonstrated that water that was exposed to positive emotions such as love and gratitude. Developed beautiful patterns while water that was exposed to negative intentions ended up disordered and lost its pattern. Maybe something similar occurs in tears. It was also found that surface tension of tears was caused due to lipocalin secreted by the lacrimal glands. From the images, we captured we can see that all three tears look very different under the microscope. The same kind of tear from all six participants looked almost similar, but the patterns of crystallization changed distinctly between two different types of tears.

As discussed earlier, basal tears are composed of water, sodium chloride, potassium chloride, oils, mucous, etc. Reflex tears are composed of the same but have increased levels of antibodies to fight foreign particles and lysozyme with bacteriolytic property. The psychic tears resembled a “lamp brush” having a lot of straight lines and most of them at right angles.

[Figure 1: Basal tears]
similar to dilute blood, with low-protein content. The pH of tears is close to that of blood plasma but with slightly greater osmotic pressure.[16] The body automatically produces specific tears depending on the cause, hence each of the tears differs in their composition. This can be partially proved by the fact that all of them form different microscopic structures on drying or crystallizing.

CONCLUSION

On collecting different types of tears and studying under the microscope, we observed various patterns. These patterns were formed due to crystallization of the salt content in tears along with its other components. The three different tears observed, namely, basal, reflex, and psychic produced different patterns on drying. This shows that they had different compositions. Therefore, the tears produced by our body during various conditions are not the same. In other words, the type of tear produced depends on the cause of its production.

REFERENCES


Figure 2: Reflex tears

Figure 3: Psychic tears

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