

## Brief Report

# The Skinny on Moisturizers: A Brief Report

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## ABSTRACT

### Objective

To compare the effectiveness of 5 different skin moisturizers using JELL-O<sup>®</sup> as a model for the human skin.

### Methods

In this study five different moisturizers (Equate<sup>®</sup>, Burt's Bees<sup>®</sup>, Suave<sup>®</sup>, Aveeno<sup>®</sup> and Vaseline<sup>®</sup>) were applied to equivalent samples of JELL-O<sup>®</sup>. Observations were made over a 12-day period and data was collected at 15 different time intervals. The primary outcome was the height (cm) and weight (g) of the JELL-O<sup>®</sup> sample at each time interval. The study was an *ex vivo* experiment conducted in a home laboratory. No Institutional Review Board (IRB) approval was required since the research does not involve living organisms.

### Results

Overall, the JELL-O<sup>®</sup> sample that had the Vaseline<sup>®</sup> applied on it had the lowest loss of height and weight. The height stayed at 100% of its original value and the weight only decreased to 97.2% of the original value by the end of the observation period. In contrast, the sample which had Suave<sup>®</sup> applied to the surface its height and weight decrease the most (42% and 28% respectively). The other moisturizers had effects intermediate between these two extremes.

### Conclusion

Based on this *ex vivo* head to head study using JELL-O<sup>®</sup> as a model for the human skin the 5 moisturizers examined had widely differing levels of effectiveness with Vaseline<sup>®</sup> appearing to be the most protective against evaporative losses and Suave<sup>®</sup> appearing to be the least.

### Keywords

Moisturizers; Dry skin; Different moisturizers; Skin lotions; Vaseline<sup>®</sup> effectiveness.

## INTRODUCTION

The skin consists of three distinctive layers.<sup>1</sup> These are the epidermis, dermis, and hypodermis. The epidermis is the outermost layer of the skin, and it provides a waterproof barrier and creates our skin tone.<sup>2</sup> The epidermis consists of further layers: stratum basale, stratum spinosum, stratum granulosum, stratum lucidum, and stratum corneum.

It is the water content of the outermost layer of skin that makes the difference between normal skin and dry skin.<sup>2,4</sup> Normally, the stratum corneum has the same surface area as the skin layers beneath it. When its water content is low, however, this layer shrinks in volume and surface area. As it tightens against the skin below, it eventually cracks, producing that flaky or scaly appearance that is recognized as the dry skin. The stratum corneum is always

losing water through evaporation, but factors such as extreme heat and dry weather can increase this evaporation.<sup>5</sup> The skin produces natural oils to help seal the water, but bathing, as well as harsh soaps and detergents, deplete these natural oils. One of the things that can be done to help prevent dry skin is to use moisturizers.

Often doctors recommend treating dry skin with moisturizers (which helps keep the skin moist), such as ointments, creams, and lotions. Dry skin may be lacking water or important oils that help keep the skin moist. Moisturizers contain many ingredients that work to add, or retain oils and water in the skin.

The primary aim of this study was to directly compare 5 common moisturizers on the market in terms of their effectiveness in preventing dry skin due to evaporative losses.

**MATERIALS AND METHODS**

**Study Design**

During the study, JELL-O® in petri dishes were used as the skin model. The petri dishes used were empty containers filled with JELL-O® to act as the base. The height (cm) and weight (g) of the JELL-O® was noted at each time point. In order to make things more standardized, the height and weight were expressed as a percentage. This was an *ex vivo* experiment comparing the aforementioned 5 moisturizers. Repeated measurements were taken at 15 different time points over 12 days. During the study, the constant variables were the temperature (°F) and the environment that the petri dishes were kept in, the JELL-O® (in terms of brand and color, which was yellow), weight scale (the petri dishes were measured on the same scale), metric ruler the petri dishes were measured with the same ruler, the amount of JELL-O® i.e. 30 ml that was kept in the refrigerator with a temperature around 37 °F for 4 hours once it was made.

**Skin Model**

The skin model used during the study was JELL-O® in petri dishes. JELL-O® is a gelatin dessert mostly made from water and gelatin, which is a substance derived from collagen. Collagen is a group of fibrous proteins found in many tissues in humans and other animals, where it helps to connect and support tissues. It is commonly found in the skin and is particularly important in the dermis layer.

**Exposure Groups**

In this study, there were 5 different exposure groups: Vaseline®, Equate®, Aveeno®, Burt's Bees®, and Suave®. These five moisturizers were chosen because their specific ingredients make them different from each other.

**Control Group**

During the study, the controls were the three petri dishes that had only JELL-O® on the dish.

**Primary Outcome Variables**

The primary outcome variables were the height and weight of the JELL-O® at each time point. To make things more standardized we expressed height and weight as a percentage of the starting height and weight of each JELL-O® sample.

**Research Methods**

Following the instructions on the JELL-O® box, the sample was prepared. Fifty milliliter of the sample was placed in each petri dish prior to refrigeration. The samples were refrigerated for four hours.

The height and weight of each JELL-O® sample was measured before adding the moisturizers. Two tablespoons (30 ml) each of moisturizer was added to each of the three petri dishes assigned to that moisturizer. Using a plastic knife, the moisturizer was evenly spread across the entire surface. Lastly, one set of measurements were taken. An hour later, another set of measurements were made. Measurements were taken on a daily basis for 12-days following this . Each moisturizer was applied to three samples. This created a total of 45 data points for each moisturizer and the control for a total of 270 data points.

**Data Management and Statistical Analysis**

Microsoft Excel® was used for data management and in generating descriptive statistics as well as basic graphs.

**Table 1. Change in Height (centimeters) of JELL-O® Sample Over Time (hours) After Application of Various Topical Moisturizers**

| Time (in hours) | Height (in centimeters) |      |      |               |      |      |        |      |      |         |      |      |           |      |      |         |      |      |
|-----------------|-------------------------|------|------|---------------|------|------|--------|------|------|---------|------|------|-----------|------|------|---------|------|------|
|                 | Equate®                 |      |      | Burt's Bee's® |      |      | Suave® |      |      | Aveeno® |      |      | Vaseline® |      |      | JELL-O® |      |      |
|                 | T1                      | T2   | T3   | T1            | T2   | T3   | T1     | T2   | T3   | T1      | T2   | T3   | T1        | T2   | T3   | T1      | T2   | T3   |
| JELL-O*         | 0.60                    | 0.60 | 0.60 | 0.60          | 0.60 | 0.60 | 0.60   | 0.60 | 0.60 | 0.60    | 0.60 | 0.60 | 0.60      | 0.60 | 0.60 | 0.60    | 0.60 | 0.60 |
| 0               | 0.60                    | 0.60 | 0.60 | 0.60          | 0.60 | 0.60 | 0.60   | 0.60 | 0.60 | 0.60    | 0.60 | 0.60 | 0.60      | 0.60 | 0.60 | 0.60    | 0.60 | 0.60 |
| 1               | 0.60                    | 0.60 | 0.60 | 0.50          | 0.50 | 0.50 | 0.60   | 0.60 | 0.60 | 0.60    | 0.60 | 0.60 | 0.60      | 0.60 | 0.60 | 0.55    | 0.55 | 0.55 |
| 24              | 0.59                    | 0.60 | 0.60 | 0.50          | 0.50 | 0.49 | 0.60   | 0.60 | 0.60 | 0.60    | 0.60 | 0.60 | 0.60      | 0.60 | 0.60 | 0.50    | 0.50 | 0.50 |
| 48              | 0.55                    | 0.55 | 0.55 | 0.45          | 0.45 | 0.45 | 0.60   | 0.60 | 0.60 | 0.60    | 0.60 | 0.60 | 0.60      | 0.60 | 0.60 | 0.49    | 0.49 | 0.49 |
| 72              | 0.54                    | 0.54 | 0.54 | 0.42          | 0.42 | 0.42 | 0.50   | 0.50 | 0.50 | 0.60    | 0.60 | 0.60 | 0.60      | 0.60 | 0.60 | 0.40    | 0.40 | 0.40 |
| 96              | 0.53                    | 0.52 | 0.53 | 0.39          | 0.38 | 0.39 | 0.50   | 0.49 | 0.50 | 0.55    | 0.55 | 0.55 | 0.60      | 0.60 | 0.60 | 0.35    | 0.35 | 0.35 |
| 120             | 0.50                    | 0.50 | 0.50 | 0.31          | 0.32 | 0.32 | 0.48   | 0.48 | 0.48 | 0.55    | 0.54 | 0.55 | 0.60      | 0.60 | 0.60 | 0.30    | 0.30 | 0.30 |
| 144             | 0.50                    | 0.50 | 0.50 | 0.29          | 0.30 | 0.30 | 0.39   | 0.40 | 0.40 | 0.54    | 0.54 | 0.54 | 0.60      | 0.60 | 0.60 | 0.20    | 0.20 | 0.20 |
| 168             | 0.50                    | 0.50 | 0.50 | 0.29          | 0.29 | 0.29 | 0.30   | 0.30 | 0.30 | 0.53    | 0.53 | 0.53 | 0.60      | 0.60 | 0.60 | 0.18    | 0.18 | 0.18 |
| 192             | 0.50                    | 0.49 | 0.50 | 0.27          | 0.26 | 0.27 | 0.22   | 0.22 | 0.21 | 0.51    | 0.51 | 0.51 | 0.60      | 0.60 | 0.60 | 0.17    | 0.17 | 0.17 |
| 216             | 0.50                    | 0.49 | 0.50 | 0.26          | 0.26 | 0.25 | 0.20   | 0.20 | 0.20 | 0.50    | 0.50 | 0.50 | 0.60      | 0.60 | 0.60 | 0.15    | 0.15 | 0.15 |
| 240             | 0.49                    | 0.49 | 0.49 | 0.25          | 0.24 | 0.25 | 0.19   | 0.18 | 0.19 | 0.50    | 0.50 | 0.50 | 0.60      | 0.60 | 0.60 | 0.11    | 0.11 | 0.11 |
| 264             | 0.49                    | 0.49 | 0.49 | 0.24          | 0.23 | 0.24 | 0.18   | 0.18 | 0.18 | 0.50    | 0.50 | 0.50 | 0.60      | 0.60 | 0.60 | 0.10    | 0.10 | 0.10 |
| 288             | 0.49                    | 0.49 | 0.49 | 0.23          | 0.23 | 0.23 | 0.17   | 0.17 | 0.17 | 0.50    | 0.50 | 0.50 | 0.60      | 0.60 | 0.60 | 0.09    | 0.09 | 0.09 |

JELL-O\*: Jell-O alone before adding moisturizer; and T-Trail

**Table 2.** Change in Percent of Initial Height (centimeters) of JELL-O® Sample Over Time (hours) After Application of Various Topical Moisturizers

| Percent of Initial Height |         |              |        |         |           |         |
|---------------------------|---------|--------------|--------|---------|-----------|---------|
| Hours                     | Equate® | Burts Bee's® | Suave® | Aveeno® | Vaseline® | JELL-O® |
| 0                         | 100%    | 100%         | 100%   | 100%    | 100%      | 100%    |
| 1                         | 100%    | 83.3%        | 100%   | 100%    | 100%      | 91.7%   |
| 24                        | 100%    | 83.3%        | 100%   | 100%    | 100%      | 83.3%   |
| 48                        | 91.7%   | 75.0%        | 100%   | 100%    | 100%      | 81.7%   |
| 72                        | 90.0%   | 70.0%        | 83.3%  | 100%    | 100%      | 66.7%   |
| 96                        | 88.3%   | 65.0%        | 83.3%  | 91.7%   | 100%      | 58.3%   |
| 120                       | 83.3%   | 53.3%        | 80.0%  | 91.7%   | 100%      | 50.0%   |
| 144                       | 83.3%   | 50.0%        | 66.7%  | 90.0%   | 100%      | 33.3%   |
| 168                       | 83.3%   | 48.3%        | 50.0%  | 88.3%   | 100%      | 30.0%   |
| 192                       | 83.3%   | 45.0%        | 36.7%  | 85.0%   | 100%      | 28.3%   |
| 216                       | 83.3%   | 43.3%        | 33.3%  | 83.3%   | 100%      | 25.0%   |
| 240                       | 81.7%   | 41.7%        | 31.7%  | 83.3%   | 100%      | 18.3%   |
| 264                       | 81.7%   | 40.0%        | 30.0%  | 83.3%   | 100%      | 16.7%   |
| 288                       | 81.7%   | 38.3%        | 28.3%  | 83.3%   | 100%      | 15.0%   |

**Table 3.** Change in Weight (grams) of JELL-O® Sample Over Time (hours) After Application of Various Topical Moisturizers

| Time (in hours) | Weight (in Grams) |       |       |              |       |       |        |       |       |         |       |       |           |       |       |         |       |       |
|-----------------|-------------------|-------|-------|--------------|-------|-------|--------|-------|-------|---------|-------|-------|-----------|-------|-------|---------|-------|-------|
|                 | Equate®           |       |       | Burts Bee's® |       |       | Suave® |       |       | Aveeno® |       |       | Vaseline® |       |       | JELL-O® |       |       |
|                 | T1                | T2    | T3    | T1           | T2    | T3    | T1     | T2    | T3    | T1      | T2    | T3    | T1        | T2    | T3    | T1      | T2    | T3    |
| JELL-O*         | 62.50             | 62.50 | 62.50 | 62.50        | 62.50 | 62.50 | 62.50  | 62.50 | 62.50 | 62.50   | 62.50 | 62.50 | 62.50     | 62.50 | 62.50 | 62.50   | 62.50 | 62.50 |
| 0               | 76.30             | 76.30 | 76.30 | 74.57        | 74.43 | 74.50 | 81.30  | 81.30 | 81.30 | 80.70   | 80.70 | 80.70 | 87.20     | 87.20 | 87.21 | 62.50   | 62.50 | 62.50 |
| 1               | 76.31             | 76.30 | 76.29 | 74.55        | 74.45 | 74.50 | 81.24  | 81.33 | 81.32 | 80.69   | 80.70 | 80.70 | 87.20     | 87.21 | 87.20 | 59.00   | 59.00 | 59.00 |
| 24              | 76.20             | 76.19 | 76.21 | 73.32        | 73.30 | 73.28 | 80.19  | 80.20 | 80.20 | 79.00   | 79.00 | 79.00 | 87.00     | 87.00 | 87.00 | 51.30   | 51.30 | 51.30 |
| 48              | 76.10             | 76.10 | 76.10 | 69.70        | 69.64 | 69.76 | 78.31  | 78.26 | 78.32 | 75.31   | 75.25 | 75.25 | 86.90     | 86.91 | 86.90 | 44.40   | 44.40 | 44.40 |
| 72              | 76.10             | 76.09 | 76.10 | 67.20        | 66.90 | 66.90 | 69.30  | 69.30 | 69.30 | 73.10   | 73.10 | 73.10 | 86.81     | 86.80 | 86.80 | 37.90   | 37.90 | 37.90 |
| 96              | 76.00             | 76.00 | 76.00 | 64.69        | 64.71 | 64.70 | 61.29  | 61.30 | 61.30 | 71.70   | 71.69 | 71.69 | 86.69     | 86.72 | 86.70 | 32.90   | 32.90 | 32.90 |
| 120             | 76.00             | 76.00 | 76.00 | 62.40        | 62.40 | 62.40 | 55.89  | 55.90 | 55.90 | 70.60   | 70.60 | 70.60 | 86.50     | 86.51 | 86.50 | 27.90   | 27.90 | 27.90 |
| 144             | 75.90             | 75.90 | 75.90 | 60.17        | 60.20 | 60.23 | 51.33  | 51.44 | 51.42 | 69.49   | 69.50 | 69.50 | 86.30     | 86.31 | 86.30 | 25.70   | 25.70 | 25.70 |
| 168             | 75.80             | 75.80 | 75.80 | 58.26        | 58.34 | 58.30 | 47.60  | 47.60 | 47.60 | 68.52   | 68.45 | 68.45 | 86.29     | 86.30 | 86.30 | 24.90   | 24.90 | 24.90 |
| 192             | 75.79             | 75.80 | 75.80 | 56.80        | 56.80 | 56.80 | 41.87  | 41.89 | 41.95 | 67.70   | 67.70 | 67.70 | 86.22     | 86.17 | 86.22 | 24.70   | 24.70 | 24.70 |
| 216             | 75.71             | 75.70 | 75.69 | 55.22        | 55.36 | 55.32 | 37.81  | 37.78 | 37.80 | 66.90   | 66.90 | 66.90 | 86.22     | 86.15 | 86.22 | 24.60   | 24.60 | 24.60 |
| 240             | 75.71             | 75.70 | 75.69 | 53.60        | 53.60 | 53.59 | 36.69  | 36.70 | 36.70 | 66.30   | 66.30 | 66.30 | 85.20     | 85.20 | 85.20 | 24.60   | 24.60 | 24.60 |
| 264             | 75.60             | 75.60 | 75.60 | 52.00        | 52.00 | 52.00 | 35.67  | 35.67 | 35.77 | 65.80   | 65.79 | 65.79 | 84.90     | 84.91 | 84.90 | 24.50   | 24.50 | 24.50 |
| 288             | 75.60             | 75.60 | 75.60 | 50.50        | 50.51 | 50.50 | 34.80  | 34.80 | 34.80 | 68.10   | 65.10 | 65.10 | 84.81     | 84.80 | 84.80 | 24.50   | 24.50 | 24.50 |

JELL-O\*- Jell-O alone before adding moisturizer; and T-Trail

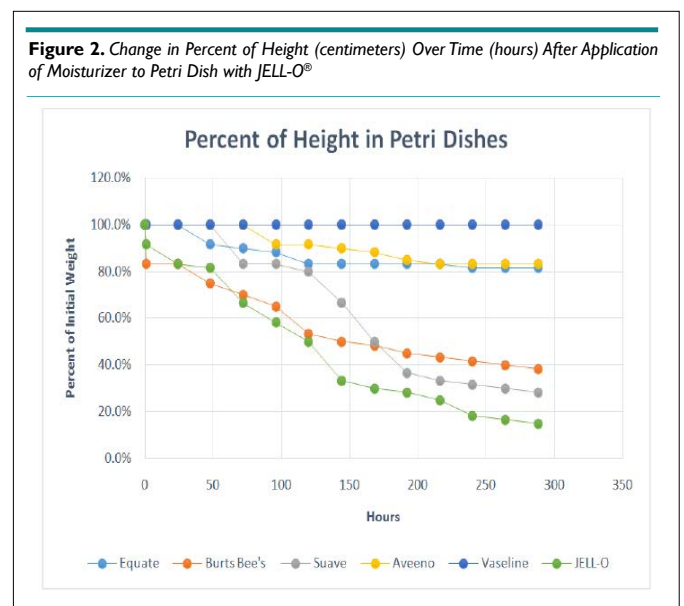
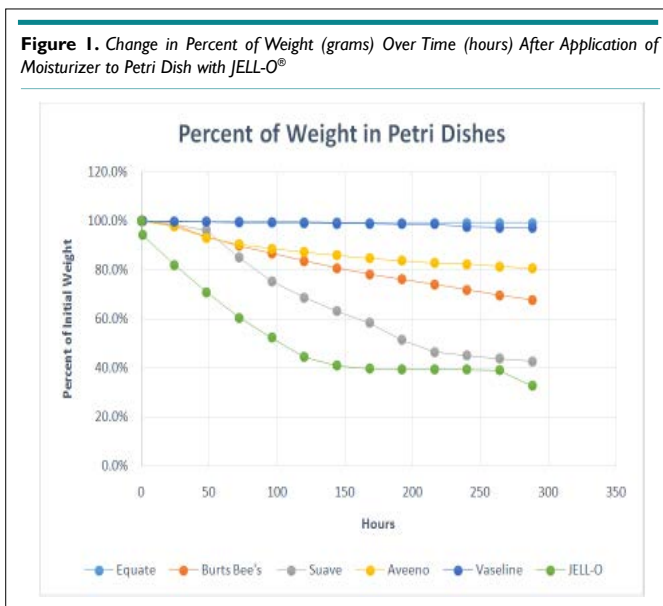
**RESULTS**

Overall, the JELL-O® sample that had the Vaseline® applied on it had the lowest loss of height and weight. The height stayed at 100% of its original value and the weight only decreased to 97.2% of the original value by the end of the observation period. In contrast, the sample which had Suave® applied to the surface saw its height and weight decrease the most (42% and 28% respectively).

The other moisturizers had effects intermediate between these two extremes. The results of the experiment are shown in Tables 1 (change in height of JELL-O® over time), 2 (change in percent of initial height of JELL-O® over time), 3 (change in weight of JELL-O® over time), and 4 (change in percent of initial weight of JELL-O® over time) and in Figures 1 (change in percent of weight over time) and 2 (change in percent of height over time).

**Table 4.** Change in Percent of Initial Weight (grams) of JELL-O® Sample Over Time (hours) After Application of Various Topical Moisturizers

| Percent of Weight in Petri Dishes |         |              |        |         |           |         |
|-----------------------------------|---------|--------------|--------|---------|-----------|---------|
| Time (in Hours)                   | Equate® | Burts Bee's® | Suave® | Aveeno® | Vaseline® | JELL-O® |
| 0                                 | 100%    | 100%         | 100%   | 100%    | 100%      | 100%    |
| 1                                 | 100%    | 100%         | 100%   | 100%    | 100%      | 94.4%   |
| 24                                | 99.9%   | 98.4%        | 98.6%  | 97.9%   | 99.8%     | 82.1%   |
| 48                                | 99.7%   | 93.6%        | 96.3%  | 93.3%   | 99.7%     | 71.0%   |
| 72                                | 99.7%   | 89.9%        | 85.2%  | 90.6%   | 99.5%     | 60.6%   |
| 96                                | 99.6%   | 86.8%        | 75.4%  | 88.8%   | 99.4%     | 52.6%   |
| 120                               | 99.6%   | 83.8%        | 68.8%  | 87.5%   | 99.2%     | 44.6%   |
| 144                               | 99.5%   | 80.8%        | 63.2%  | 86.1%   | 99.0%     | 41.1%   |
| 168                               | 99.3%   | 78.3%        | 58.5%  | 84.9%   | 99.0%     | 39.8%   |
| 192                               | 99.3%   | 76.2%        | 51.5%  | 83.9%   | 98.9%     | 39.5%   |
| 216                               | 99.2%   | 74.2%        | 46.5%  | 82.9%   | 98.9%     | 39.4%   |
| 240                               | 99.2%   | 71.9%        | 45.1%  | 82.5%   | 97.7%     | 39.4%   |
| 264                               | 99.1%   | 69.8%        | 43.9%  | 81.5%   | 97.4%     | 39.2%   |
| 288                               | 99.1%   | 67.8%        | 42.8%  | 80.7%   | 97.2%     | 32.8%   |



**DISCUSSION**

This study describes a novel *ex vivo* experiment to assess the effectiveness of five different skin moisturizers. Loss of height and weight of the JELL-O® samples was used to simulate trans epidermal water loss in the human skin. Vaseline® seemed to have the highest effectiveness while Suave® appeared to have the least.

Our results are broadly consistent with prior studies though we could not find a head to head study that compared multiple moisturizers due to how we carried out this experiment. A prior study argued that Vaseline® petroleum jelly, in a minimum concentration of 5% is the most effective occlusive as it reduces transepidermal water loss by as much as 98%.<sup>5</sup> Vaseline® is thought to primarily work by acting as an occlusive. One study showed that Vaseline® petroleum jelly actually accelerated skin recovery after

artificial disruption using acetone.<sup>6</sup> The study found that Vaseline® permeates through the stratum corneum interstices allowing recovery of the skin despite its occlusive properties.

Measuring the effect of topical moisturizers on changes in stratum corneum thickness *in vivo* requires expensive techniques such as confocal Raman spectroscopy.<sup>7</sup> We demonstrate a low cost *ex vivo* alternative way of assessing the effect of different topical moisturizers in terms of their effectiveness in preventing or reducing water loss.

**STRENGTHS AND LIMITATIONS**

It is believed that the technique used in this study was both a strength and a limitation. It was a strength because it were non-

invasive and allowed the experiment to be repeated multiple times with strict quality control. At the same time, because this was an *ex vivo* study, we cannot surely say that the results would have been the same if performed on human beings. This is due to humans having various skin types, like dry and oily skin, which could lead to an alteration in which products best suit them. Therefore, further research is warranted in order to improvised the results.

## CONCLUSION

In conclusion, based on this *ex vivo* head to head study using JELL-O® as a model for the human skin the 5 moisturizers examined had widely differing levels of effectiveness with Vaseline® appearing to be the most protective against evaporative losses and Suave® appearing to be the least.

## NOTE

The author is a scholar at Townview Talented and Gifted (TAG) Magnet School in Dallas, Texas which is constantly rated as a top high school in the United States (currently ranked #11 as per U.S. News). At the age of 12, she became one of the youngest authors within and outside of the United States by publishing a novel, “Ancient Dynasty Chronicles: The Untold Truth,” which is available on Amazon and many other locations. She donated the book’s proceeds to her previous school, Uplift North Hills Preparatory (50%) and the St. Jude Children’s Cancer Research Hospital (50%). Currently, she is preparing to publish her second book in the end of 2019. Additionally, she is a recipient of multiple piano awards, a person who strives to help the people around her through kind acts, and a straight “A” student at school.

Last year, during the science fair conducted by University of Texas (UT) Southwestern in Dallas, this study/research on “The Skinny on Moisturizers” received the prestigious UT Southwestern STARS award. The same study has been extended as an academic journal. The author wished to publish her research work to the academic world, as she believes that she will not only learn from this experience, perhaps even inspire the people around her to feel enthusiastic about the scientific area.

**EIC’s Comments:** “This work is done by a high school student and we are publishing this as it fits into our mission of promoting

and encouraging studies in science, technology, engineering and mathematics (STEM) field for our next generation”.

## DISCLOSURE

I certify that no funding has been received for the conduct of this study and/or preparation of this manuscript. I certify that the study does not promote any commercial product and I haven’t received any compensation from the companies for the study or publication.

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