PHYTIC ACID

Organic acid extracted from rice bran that has antioxidant properties

Phytic Acid has some more benefits to offer to cosmetic products. Moisturizing and sebum control effects have been found and phytic acid shows the activity as a skin lightening agent. The mainly using of phytic acid for cosmetic is moisturizing effect, deodorizing effect, and chelating effect.

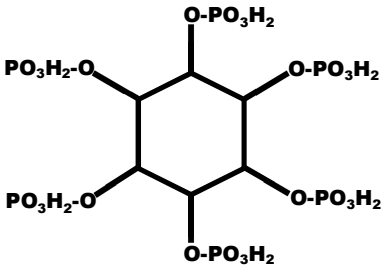

Figure 1: Structure of phytic acid.

1. The effects of phytic acid on the skin moisturizing and sebum

For healthy skin, it is important to maintain a balance between skin's moisture and sebum. Dry skin easily becomes harsh at low sebum content, whereas in oily skin too much sebum could cause a pimple and overexpansion of skin pores [1]. Therefore, the moisture skin lotion is often used to control amounts of moisture and sebum on the skin and to maintain moisturized skin.

In order to study the effect of the amount of phytic acid in skin lotion on the moisture of skin, the skin lotion containing phytic acid at 0, 0.15, 0.25, 0.5, 1.0 and 1.5 wt% was applied evenly on the specific area on the arm of the volunteers for 7 weeks.

Moisture of the skin is measured with aquameter (Corneometer®) at 21°C under the condition of moisture content of 65%.

Figure 2 shows the amount of moisture of the skin after applying the skin lotion containg various concentrations of phytic acid. Average moisture value of the skin prior to the application of the lotion was 54.25. In the absence of phytic acid (placebo), a slightly change occurred in the moisture value of the skin after 7 weeks. The moisture of the skin increased at the higher concentration of phytic acid. However, the moisturizer increased rapidly by 4 weeks application with the skin lotion containing 0.5, 1.0, and 1.5 wt%. A 0.5 wt% phytic acid-containing lotion showed the moisture value quite similar to those of the skin lotion containing 1.0 and 1.5 wt% phytic acid.

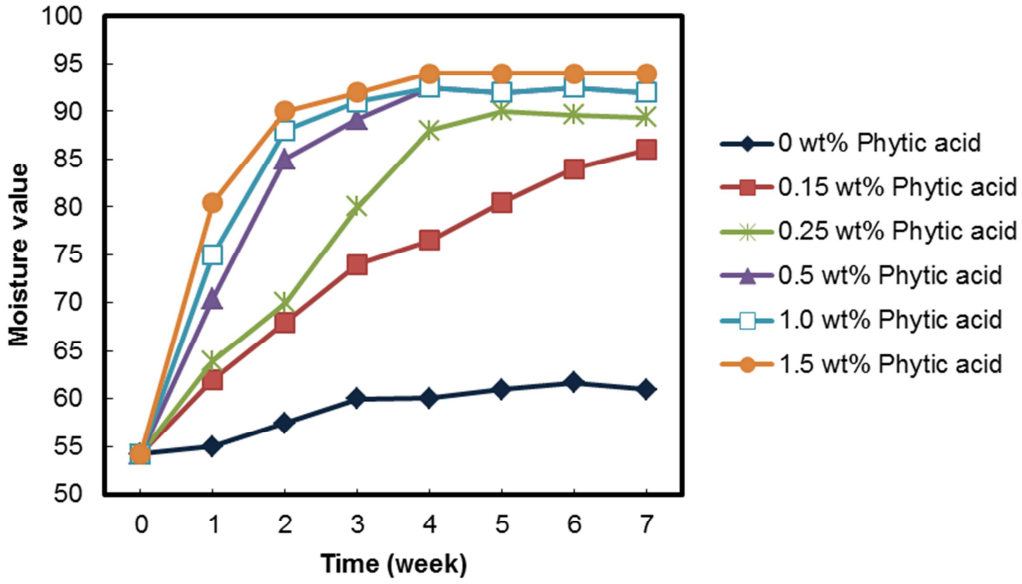

Figure 2: Moisture values after applying the phytic acid-containing skin lotions at various concentrations. (Provided by Dr. Zhong ,Soongsil University)

Since the skin lotion containing 0.5 wt% phytic acid showed an optimal moisture increase (Figure 2), two skin lotions with 0 and 0.5 wt% phytic acid were used for sebum evaluation.

Skin's sebum is produced when sebaceous glands within the pore secrete fats. Sebaceous glands secret sebum to skin surface to keep skin moisture [2]. Sebum values of the skin were widely varied from 20 $\mu g/cm^2$ to 223 $\mu g/cm^2$ before the application of any skin lotions. Therefore, the skin with the sebum values below or equal to 60 $\mu g/cm^2$ was designated as dry skin, the skin with the sebum values above or equal to 190 $\mu g/cm^2$ was assigned as oily skin

Figure 3 shows the sebum values of dry and oily skins of the subjects after applying 0 and 0.5 wt% phytic acid-containing skin lotions. The values were measured each week for a period of 7 weeks. The application of the skin lotion containing 0.5 wt% phytic acid substantially changed the sebum value during 4 weeks in both oily and dry skin. In dry skin, the average sebum value increased to 99 $\mu g/cm^2$ after 4 weeks of application from 30 $\mu g/cm^2$ before application. The average sebum value in the oily skin decreased to 130 $\mu g/cm^2$, which was closed to the value for neutral skin, from 210 $\mu g/cm^2$ before application of the skin lotion.

This result indicated that the use of the skin lotion containing 0.5 wt% phytic acid could effectively change the sebum values of dry and oily skin to the values between 90 and 130 $\mu g/cm^2$, which closely matched the value of normal skin. This could be due to absorption of phytic acid into the pores after its penetration into stratum corneum and, consequently, maintaining the appropriate amount of sebum secreted from the sebaceous gland [3, 4]

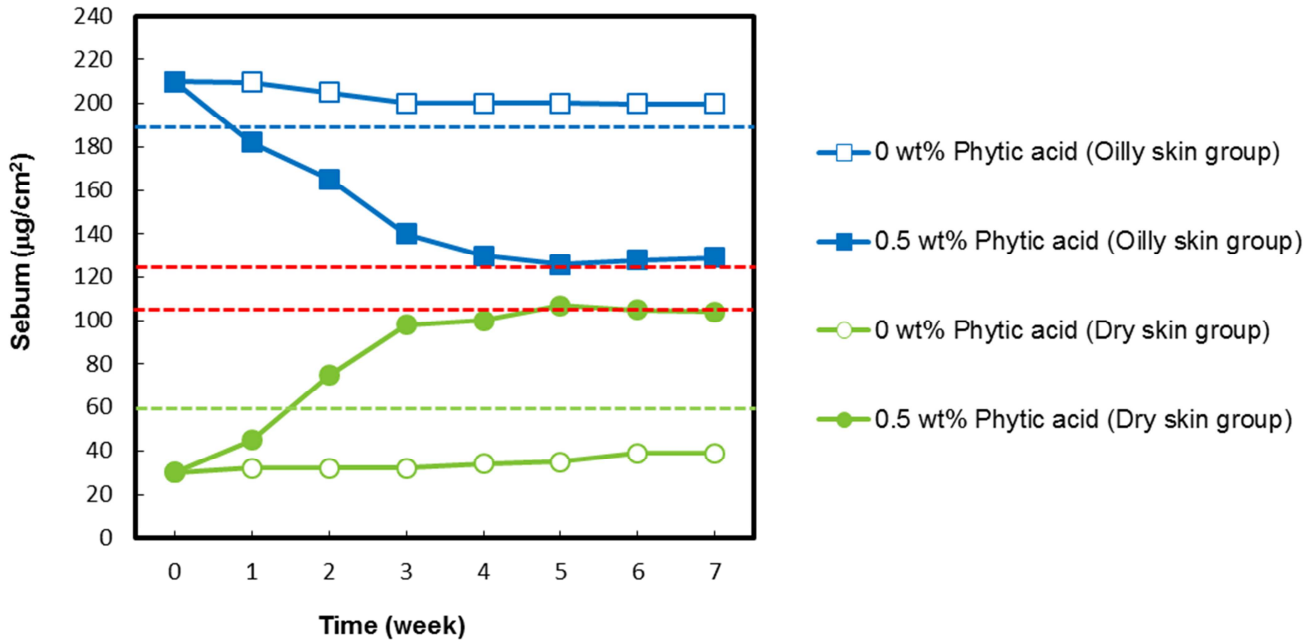

Figure 3: Sebum value for dry skin (green line) and oily skins (blue line) after applying the 0 wt% (placebo) (open symbols) and 0.5 wt% (filled symbols) phytic acid-containing skin lotions for 7 weeks (The area below green dashed line showed the sebum value of dry skin, The area above blue dashed line showed the sebum value of oily skin, The area between red dashed lines showed the optimum amount of sebum for the natural skin of 105-125 $\mu g/cm^2$). (Provided by Dr. Zhong ,Soongsil University)

2. The lightening effects of phytic acid on the skin

Color of skins is due to the presence of melanine, which is produced by melanine cells located between stratum corneum forming cells. To minimize skin coloring functional cosmetics containing lightening agent are often used [5, 6].

The melanine values were investigated after applying the skin lotions containing various concentrations of phytic acid of 0, 0.15, 0.25, 0.5, 1.0, and 1.5 wt% on the specific area of the volunteer's arm.

Figure 4 shows that in placebo sample no change occurred in the melanine value after 7 weeks of application. Higher concentration of phytic acid, higher the melanin values decrease. The skin lotion containing 0.5 wt% phytic acid showed similar melanin value to those of the skin lotion containing 1.0 and 1.5 wt% phytic acid.

These results reveled that regardless of concentrations of phytic acids the application of the skin lotion containing phytic acid reduced melanin values. This is because the penetration of phytic acid into basale layer inhibited the activity of tyrosinase, which involved in melanin synthesis, resulting in improved lightening effect. The optimal concentration of phytic acid in skin lotion was 0.5 wt%.

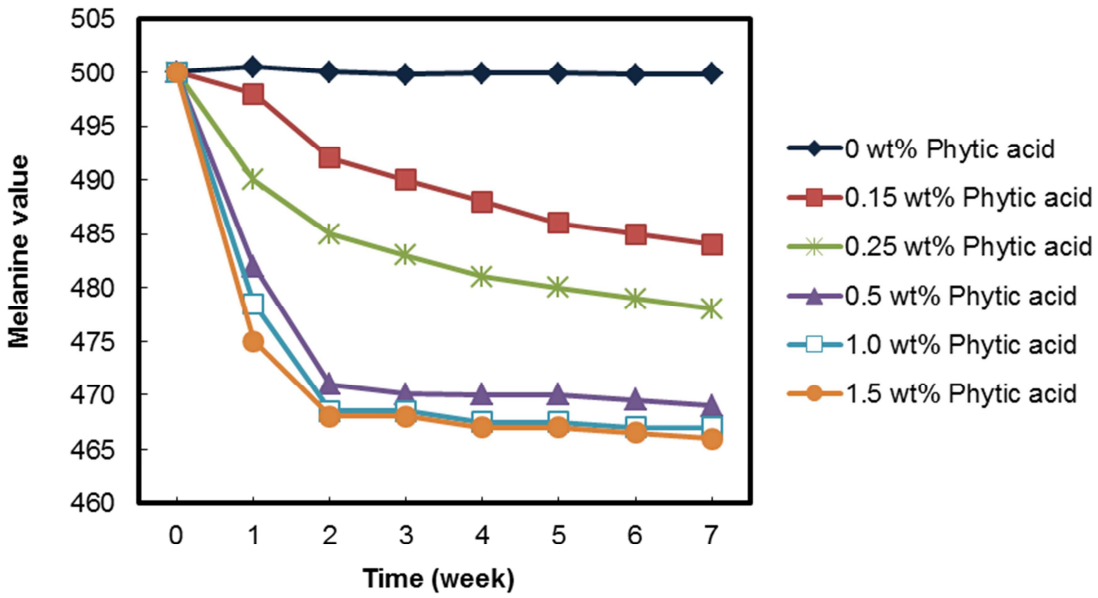

Figure 4: Melanin values after applying various concentrations of phytic acid containing skin lotion. (Provided by Dr. Zhong ,Soongsil University)

3. The effects of phytic acid on the elasticity of the skin

The combined effects of moisture, sebum, and connective tissue contribute to the elasticity of skin. As time passes, reproduction ability of skin cells decreases, transformation of hypodermis occurs, and elastin fibrous tissue bonds are weakened. Connective tissue is composed of cellular group, such as fibroblast, collagen, stellate cells, and gel-like intercellular compositions containing elastin, collagen, and network structure. It is also connected to hypodermis-apipose tissue [7].

Figure 5 shows skin elasticity after applying the skin lotions with 0 and 0.5 wt% phytic acid on the face of volunteers at age 20-30 years old and 40-50 years old. For the application of the placebo, the elasticity of both group of ages showed no substantial difference in the skin elasticity by age. On the other hand, for the application of the skin lotion containing 0.5 wt% phytic acid showed increasing of the skin elasticity of both group of age.

Figure 6, using the results from Figure 5, presents the degree of elasticity improvement as the skin lotion with 0.5 wt% phytic acid. The use of phytic acid-containing skin lotion was beneficial in increasing skin elasticity and the effect was much greater for the group of age 40-50 years old than for 20-30 years old. From the result we suggest that, phytic acid was able to deliver enough moisture into collagen and elastin fibers within the dermis, resulting in an increase of skin elasticity [8].

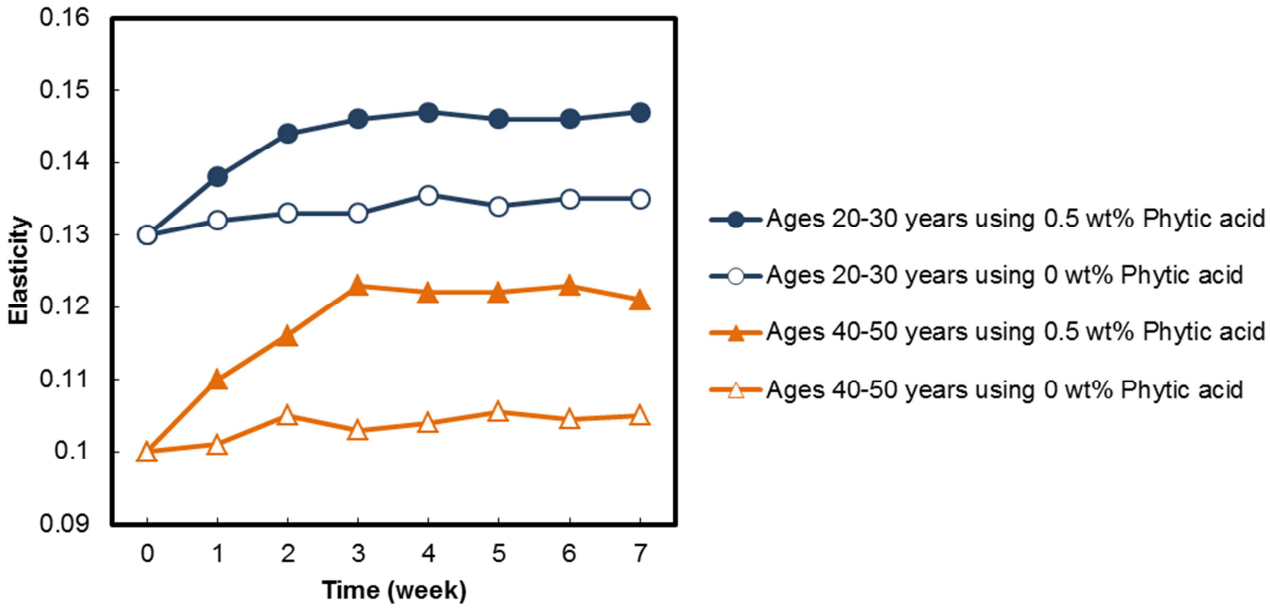

Figure 5: Elasticity of skin at ages 20-30 years old (blue line) and ages 40-50 years old (orange line) after applying 0 wt% (open symbols) and 0.5 wt% (filled symbols) phytic acid containing skin lotions for seven weeks. (Provided by Dr. Zhong ,Soongsil University)

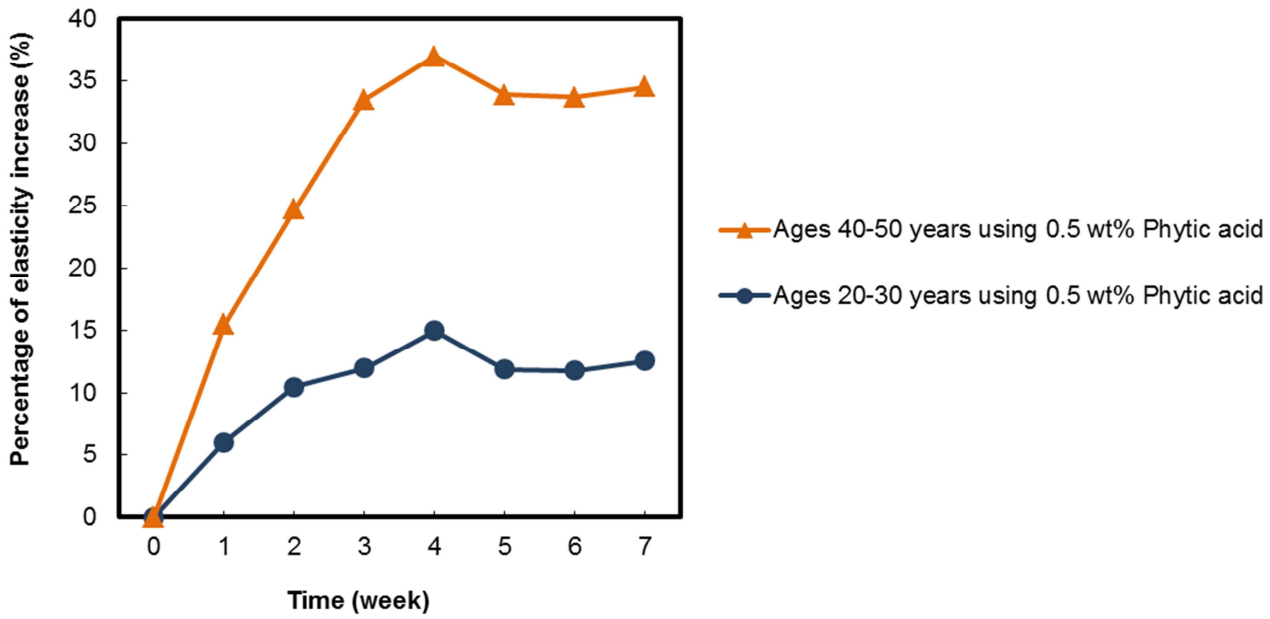

Figure 6: Degree of elasticity increase after applying the 0.5 wt% phytic acid-containing skin lotion for seven weeks. (Provided by Dr. Zhong ,Soongsil University)

4. The effects of phytic acid on the deodorization of the skin

There are the reviews about the deodorizing effect of phytic acid as shown in Table 1.

Table 1: The deodorizing effect of phytic acid.

Author (year published)	Test subject	Dose and administration	Skin efficacy
Koutaro Sakai (1992) [9]	Garlic	0.4 to 0.6% immersion	Deodorant effect against garlic odors
Sanwa Kagaku Kenkyusho (1993) [10]	Dog	0.5% in shampoo	Deodorant effect of body odor was confirmed after a few days
Yasuhiko Kobayashi *et al.* (2003) [11]	*In vitro*	0.025 to 0.4% addition	Growth inhibition against gram-negative bacteria

5. The chelating effect of phytic acid

The chelating effect was measured with potentiometric titration. The smaller the value, the stronger the chelating effect. The result indicates that 50% phytic acid shows stronger chelating effect than EDTA at pH 5-7(Figure 7).

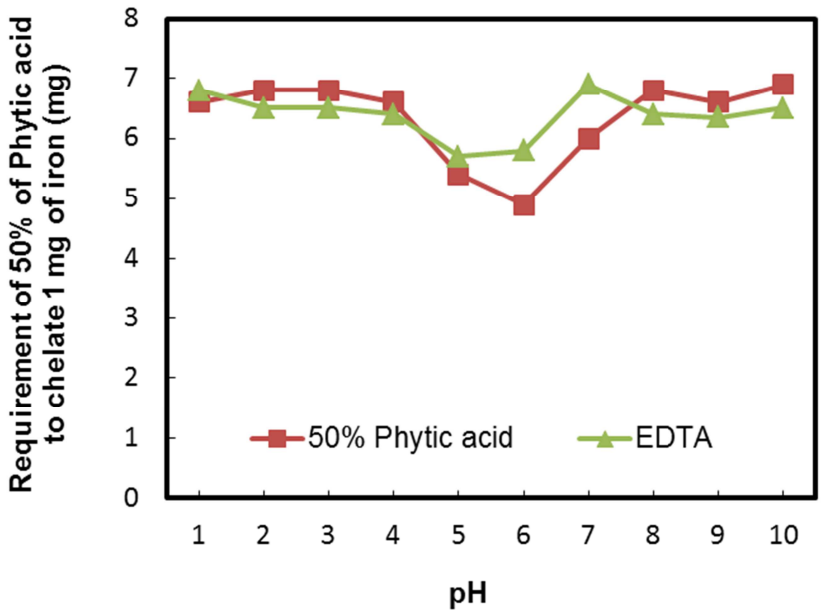

Figure 7: The chelating effect of 50% of phytic acid compare with EDTA. (In-house data)

Properties

INCI name	PHYTIC ACID
Appearance	Slight yellowish or brownish viscous liquid
Specific Gravity	1.396 (50% phytic acid solution)
Solubility	Freely soluble in water, 95% ethanol, acetone Slightly soluble in absolute ethanol Non-soluble in oil
Stability	RT 20-30°C  Refrigerator 1-10°C  Phytic acid that were stored at room temperature (left photo) turned pale brown in only two months, while samples stored in refrigerator (right photo) took six months to turn pale yellow. This suggested that the discoloration of phytic acid is suppressed at low temperature.

References

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