



WASPADA KANDUNGAN SILIKON DALAM KOSMETIK

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PENDAHULUAN

Silikon merupakan elemen kimia dengan karakteristik semimetalik, dimana silikon tidak hanya terdiri dari atom tunggal tetapi merupakan komponen kimia.¹ Dalam kehidupan sehari-hari banyak orang terpapar silikon baik dalam bentuk kosmetik, minyak silikon atau produk kosmetik seperti shampo atau kondisioner rambut. Penggunaan silikon dapat menimbulkan efek samping inflamasi kronik seperti kemerahan, edema, nekrosis hingga granuloma, sehingga FDA melarang penggunaan silikon untuk injeksi.²

METODE

Penelitian ini melibatkan 37 wanita normal dimana sampel diambil dari sisa kulit normal *facelift* dibandingkan dengan subjek lain yang telah menerima injeksi silikon dan mengalami formasi granuloma. Kadar silikon jaringan kulit diperiksa dengan menggunakan *Atomic Absorbance Spectrophotometer* (AAS) di Fakultas MIPA Universitas Indonesia. Kadar silikon diukur dalam mikrogram per gram jaringan kulit.

HASIL

Rata-rata kadar silikon pada subjek normal adalah $44.07 \pm 75.86 \mu\text{g/g}$ dan pada subjek dengan granuloma ditemukan 38 kali lipat lebih tinggi ($1709.21 \pm 1851.72 \mu\text{g/g}$).

PEMBAHASAN

Silikon memiliki sifat yang stabil.^{3,4} Dengan berkembangnya ilmu pengetahuan silikon injeksi mulai digunakan untuk kepentingan terapi kesehatan seperti pada terapi komplikasi *retinal detachment*, tetapi didapatkan komplikasi seperti inflamasi, peningkatan tekanan okular, katarak, dan peningkatan emulsifikasi minyak silikon.^{5,6}

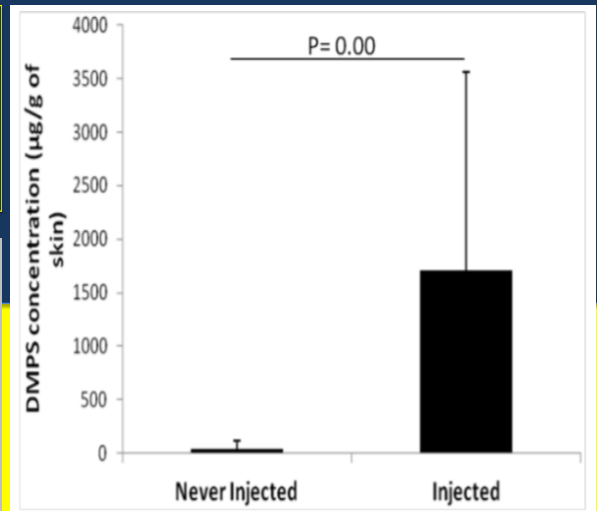
Silikon didapatkan pada makanan, kosmetik, dan industri farmasi. Data sebelumnya menunjukkan bahwa kadar silikon (Si) pada obat saluran cerna seperti antasid, air mineral dan minuman soda adalah 44.1, 25.6, and $2.91 \mu\text{g/g}$. Dapat dikatakan banyak jalan bagi silikon untuk masuk kedalam tubuh manusia.¹

Silikon banyak digunakan pada produk kecantikan wajah, rambut dan kosmetik dengan tujuan membuat tampak lebih lembut dan bersinar. Saat silikon topikal digunakan maka partikel silikon akan bercampur dengan berbagai macam cairan seperti emolien dan sebum. Hal ini digunakan sebagai *vehicle* bahan aktif untuk mengontrol minyak pada kulit.⁷

Akumulasi silikon pada kulit dicurigai akibat penggunaan kosmetik setiap hari yang mengandung silikon. Penetrasi bahan kimia yang terkandung dalam produk kosmetik dipengaruhi oleh ukuran molekuler, lipofilisitas, pH, konsentrasi penetrasi, peningkatan kimia, hidrasi kulit, enzim kulit, dan suhu. Manipulasi parameter ini dapat mendorong dermatokinetik senyawa kimia yang terkandung dalam produk kosmetik.⁸

Dalam krim, silikon dapat membentuk lapisan anti-air untuk melindungi kulit. Meskipun demikian, silikon memiliki ukuran molekul besar dan tidak mungkin untuk silikon menembus lapisan kulit. Bahan lain yang terkandung di dalam krim dapat meningkatkan penetrasi silikon.

Tingkat silikon yang rendah ditemukan jaringan kulit subjek dapat disebabkan oleh penggunaan krim sehari-hari. Karena itu, pertimbangan yang lebih besar harus diambil dalam pengembangan teknologi baru terhadap mekanisme penyerapan krim **topikal** pada kulit termasuk nanoteknologi, yang dapat menembus ke dalam kulit yang dalam jangka panjang dapat berkembang menjadi granuloma.



Gambar 1: Kadar silikon (Si) pada subjek normal yang tidak pernah menerima injeksi silikon dan subjek dengan granuloma dimana telah menerima injeksi silikon.

Kesimpulan

Penggunaan silikon sebagai bahan filler telah dilarang oleh FDA. Terdapat beberapa resiko pada penggunaan silikon topikal, terutama pada bahan baku kosmetik yang mengandung silikon. Dibutuhkan penelitian lebih lanjut untuk mengetahui bagaimana silikon dapat berpenetrasi kedalam jaringan kulit.

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Alert Silicon Content in Cosmetics Daily Uses

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Introduction

Silicone is a chemical element which has semimetallic characteristic, which derive from cross-linked polymer with methyl siloxane as the basic element. In daily life, silicone can found in simeticone (antifoams used in antacids), silicone oil and cosmetic produsts such as conditioner and shampoo to give hair silky and dazzling shine. This research was conducted with aim of evaluating silicone level in normal female skin tissue who used daily cosmetics.

Methods

The silicon levels in skin samples were measured using an atomic absorbance spectrophotometer in 37 healthy normal females who had never received silicone injection and compared with those who had developed granuloma after silicone injection.

Results

Low silicon level ($44.07 \pm 75.86 \mu\text{g/g}$) was found in skin tissues of normal individuals as compared to those who developed post-silicone granuloma ($1709.21 \pm 1851.72 \mu\text{g/g}$).

Conclusion

Silicon may be found in normal skin tissue due to daily use of cosmetic products; however the level is significantly low.

Key words

Silicon, skin, topical, accumulation.

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Pendahuluan

Silikon merupakan elemen kimia yang memiliki karakteristik semimetal yang berasal dari pertukaran polimer dengan methyl siloxane sebagai elemen dasar. Silikon dapat ditemukan dalam kehidupan sehari-hari sebagai kandungan simetikon, minyak silikon sebagai pelumasan dan dalam produk kosmetik seperti kondisioner dan shampoo untuk membuat tampak lembut dan mengkilap. Penelitian ini dilakukan dengan tujuan mengevaluasi level kandungan silikon dalam jaringan kulit pada pasien wanita yang sering menggunakan kosmetik.

Metode

Level kandungan silikon pada kulit sampel akan diukur menggunakan *atomic absorbance spectrophotometer* pada 37 wanita normal yang tidak pernah menerima injeksi silikon dan dibandingkan dengan yang telah mengalami granuloma akibat injeksi silikon.

Hasil

Level silikon yang rendah ($44.07 \pm 75.86 \mu\text{g/g}$) ditemukan dalam jaringan kulit individu normal yang dibandingkan dengan yang telah mengalami granuloma akibat injeksi silikon ($1709.21 \pm 1851.72 \mu\text{g/g}$).

Kesimpulan

Silikon dapat ditemukan pada kulit normal akibat penggunaan produk kosmetik sehari-hari sehingga penggunaannya harus diwaspadai.

Kata kunci

Silikon, kulit, topikal, akumulasi

Silicon Content Alert in Cosmetics Daily uses

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ABSTRACT

Introduction

Silicone is a chemical element which has semimetallic characteristic, which derive from cross-linked polymer with methyl siloxane as the basic element. In daily life, silicone can found in simeticone (antifoams used in antacids), silicone oil and cosmetic products such as conditioner and shampoo to give hair silky and dazzling shine. This research was conducted with aim of evaluating silicone level in normal female skin tissue who used daily cosmetics.

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INTRODUCTION

Silicon is a chemical element, which has a symbol of Si and an atomic weight value of 28. It is not a metal element and it actually has semimetallic characteristics, which means that silicon does not stand as a single atom, but rather as a chemical compound of silicon dioxide or a complex compound or silicon silicate.¹ In addition, silicone is a cross-linked polymer with methyl siloxane as the basic element. PDMS or polydimethylsiloxane is the most common silicone, which has been used in many kind of preparations such as liquid, gel and solid.^{1,2} Polymerization and the length of siloxane chain may affect its viscosity, which is measured in units of centistokes (cS). Silicone has some degree of resistance to react with oxidizing agents, such as nitric acid, sulfuric acid, chlorine and other fluids, which are more hydrophobic than fluids with similar viscosity to silicone.^{2,3}

In daily life, many people have been exposed to silicones in the form of simethicone (antifoams used in antacids), silicone oil as a lubricant for syringes and cerebrospinal shunt tubes. Silicones are also found in cosmetic products

such as hair conditioner and shampoo to give hair a silky and dazzling shine. Moreover, metalloid silicone crystals have been used widely for various needs such as transistors, electronic microchips, computers and household utilities.⁴ The use of silicone injection for reconstruction of face and other body parts was started in 1963 with a total of 200 patients in Las Vegas. Severe inflammatory effect was noted and therefore, the application was stopped. At that time, the type of injected-silicon was industrial grade with low purity and high viscosity; therefore, serious side effects such as severe inflammation were certainly found. Later, the Dow Corning Corporation produced sterile and injectable silicone with high purity and low viscosity (350cS) characteristics.² Afterwards, in 1977, Wilke obtained data of 92 individuals who had received the injectable-grade silicone injection and noticed that there were inflammatory reactions with granuloma formation in 8 individuals, which developed within a year after the injection. Ten years later, granuloma formation was also found in the other 13 individuals. On the contrary, Arohnsohn injected subcutaneous silicone in 1984 using pure and sterilized-silicon to 4,863 individuals aged over 22 years. As a result, no side effect was found.²

Since evidence-based data has been inconsistent, particularly regarding the indication and adverse effects of silicone use, FDA has decided to ban the use of silicone as filler material. However, there are still a lot of ways of silicon entering our body parts other than injection such as through oral pathway into digestive system by intake of some foods containing high levels of silicon or topical pathway by the use of face cream. Our study evaluated the silicon levels found in normal skin tissue and discussed the possible mechanisms of how the molecule can enter and migrate along our body systems. There was no prior study has reported the levels of silicon in normal skin tissues.

METHODS

Subjects

There were 37 healthy normal women participated in our study. We had requested their approval to examine their skin sample obtained from face-lift procedure. The subjects had never received silicone injection and their silicon (Si) levels were compared to other subjects who had received liquid silicone injection with a development of granuloma formation. The skin sample of subjects with granuloma were isolated from the granuloma tissue located in submental area.

Measuring Silicon (Si) Levels using Atomic Absorbance Spectrophotometer

The skin samples were analyzed and the silicon levels were measured using an atomic absorbance spectrophotometer (AAS) at an analytical chemical laboratory in Faculty of Mathematic and Natural Sciences, University of Indonesia. The levels were measured in measurement unit of microgram of silicon per gram of skin tissue.

RESULTS

Silicon levels in skin tissues were measured for both subject groups, i.e. the healthy subjects and the subjects with granuloma because of silicone injection. The skin samples were isolated from of facial area of both subject groups.

Figure 1 shows data about the levels of silicone in both subject groups. There was a significantly higher level of silicon in subjects with granuloma compared to the normal subjects. However, there was still a low level of silicon detected in the normal subjects. In the normal subject group, there were 15 subjects who had silicone in their skin samples; while in the other 22 subjects, no silicon level was detected.

Our study demonstrated that the mean value of silicon levels found in the skin sample of normal subjects was $44.07 \pm 75.86 \mu\text{g/g}$ and a 38-fold higher level of silicon was found in the skin sample of subjects with granuloma. ($1709.21 \pm 1851.72 \mu\text{g/g}$).

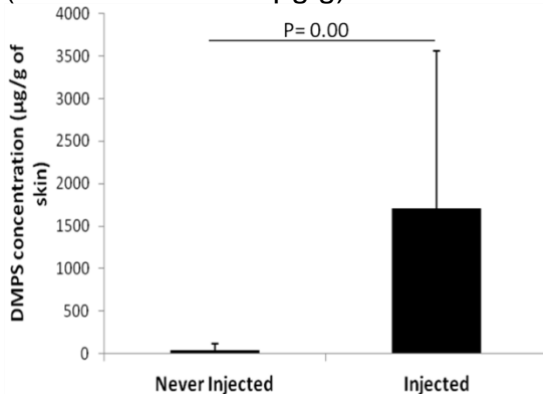


Figure 1. The level of silicon (Si) in normal subjects who had never received silicone injection (never injected) and in subjects with granuloma who had received silicone injection (injected)

DISCUSSION

Silicon has been claimed as a stable and inert element.^{5,6} With such unique properties, manufacturing companies have been producing injectable-grade silicone for medical use. For example, transconjunctival injection of silicone oil has been used to treat complicated retinal detachment and heavy silicone oil tamponade has been promising good prognosis for retinal reattachment as well as improving visual acuity and providing successful results on other anatomical parameters. Nevertheless, some complications such as mild inflammation, increasing ocular pressure, cataract and heavy silicon oil emulsification may arise.⁷⁻⁹

Silicone oil injection has also been applied to reduce the risk of developing diabetic foot ulcer. Some other studies have reported that silicone oil has pressure-reducing properties and it may have a role in increasing plantar tissue thickness.^{10,13} In spite of the advantages, some complications may still arise. Another study report showed that silicone injection in lower extremity could develop palpable nodule around injection area as well as electrical sensation, muscle fatigue, joint pain and electrical neuropathy.¹⁴ In addition to those local complications, systemic complications have also been reported including lymphadenopathy, renal disease and hepatic disease. It indicates that injected silicone can migrate from injection site to other body parts. In experimental mice model, the injected silicone could be engulfed by macrophage in skin tissue, recirculated via lymphatic vessels and accumulated in adrenal glands, lymph

nodes, liver, spleen and kidney.¹⁵ In diabetic ulcer patients, migration of silicone that has been implanted into their foot may be correlated with biomechanic activity of foot itself.

Granuloma formation due to silicone injection is dose-dependent. Figure 1 shows that only a large amount of silicon caused granuloma formation as there was a low level of silicon in the skin tissue of normal subjects, but no granuloma formation was documented.

In addition to its medical application, silicone has also been used in food industries, cosmetics and pharmaceutical industries. Our data demonstrated that the silicon (Si) levels in digestive drugs such as antacids, mineral water and soft drink was 44.1, 25.6, and 2.91 $\mu\text{g/g}$ silicone, respectively. Therefore, we can say that there are a lot of routes of silicone entering into our body.

The average daily dietary intake of silicon is 20–50 mg for European and North American populations. Daily intake of silicon is higher in China and India (140–200 mg/day) where grains, fruits and vegetables form a larger part of the diet.¹⁶ Recently, a research institution of healthy aging and nutrition in UK has reported a strong correlation between silicon diet and the health of bone and connective tissue. It is assumed that the correlation is associated with collagen synthesis and/or stabilization as well as mineralization of the matrix, in which silicone intake has some effects on bone density.¹⁷

Another study, an animal experimental study, showed that there was no evidence about silicone accumulation in oral silicone intake. Silicone can be eliminated by numerous routes including feces (93-97%), urine (0.001-0.22%) and exhaled air (0.01-0.02%).³ It indicates that silicone is a stable element and can have a certain degree of resistance against enzyme digestion as well as acidic gastric condition. Therefore, it is unlikely for silicone to accumulate in gastrointestinal system.

Beauty products for face, hair and cosmetics may contain a higher level of silicone, which is more likely to be accumulated in skin tissue. When topical silicone products are applied to the skin, silicone elastomeric particles can absorb various liquids including emollient and sebum. Therefore, it can be used for skin care as delivery vehicles for some active ingredients to the skin or to control sebum deposition in the skin.¹⁸

The capability of silicone elastomeric particles to expand in certain solvent has become their utility as therapeutic delivery agent for skin care. This unique capability and in addition to the surface area of silicone elastomeric particles can absorb various kind of oils and make the skin stays dry when it is touched. Therefore, the silicone elastomeric particles can be used as an agent to carry certain oil or ingredients or as emollient for the skin and act as mineral oil, glycerides, fat esters and sunscreen.¹⁸

Silicone elastomeric particles, which are covered by nanoparticles such as Al_2O_3 or TiO_2 , have shown soft-focus effect. In a simple description, it can be said that the soft-focus effect becomes obvious when there is minimum

reflection (<20% of total illumination), maximum total transmission (>75% of total illumination); while the disperse illumination reflection is maximum (80%) and the disperse illumination has maximum transmission (> 50%).¹⁸

When these criteria are fulfilled, the total transmission illumination reflects natural skin tone similar to the back light effect and provides natural light; while the disperse transmission will even create better skin glow and hides imperfection.¹⁸ Silicone elastomeric particles, which have been enhanced with SiO₂ particles have been proven to minimize wrinkles.¹⁸

Silicon accumulation in the skin is probably caused by topical use of applying cosmetic products, which contain silicone. The penetration of chemicals that are contained in cosmetic products is influenced by molecular size, lipophilicity, pH, penetrant concentration, chemical enhancers, skin hydration, skin enzymes, and temperature. Manipulating these parameters could be drive the dermatokinetic of chemical compounds that are contained in cosmetic products.¹⁹

In skin cream, silicon could form water-repellent layer to protect skin. Nonetheless, silicon has a large molecular size and it is impossible for silicon to penetrate skin layer without any enhancer. Another ingredient contained in the skin cream can enhance silicon penetration into deeper layer of the skin. Low level of silicon found in the skin tissue of normal subjects in our study might be caused by daily use of skin cream. Thus, it is unlikely that normal subjects have no silicon level in their skin. Therefore, greater consideration must be taken in new technology on absorption mechanism when applying topical cream on the skin including nano technology, which can penetrate into the skin and in the long term it may develop into granuloma.

CONCLUSION

The use of silicone as filler material has been banned by FDA. Nevertheless, there are still some risks of using topical silicone, particularly cosmetic products that contain silicone. Bioavailability of silicone in skin tissues and long-term complications of silicone use must be evaluated for safety reasons. Moreover, further studies should be done on how silicon can penetrate into skin tissue.

Conflict of interest

The authors declare that there is no conflict of interest.

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