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The pH of soaps, skin care products and cosmetics used in the period of COVID-19 pandemic

Abstract

Introduction. Human skin is the outer cover of the body. It performs important functions for the entire organism, such as protection of internal organs. The skin also protects the body against the effects of the external environment, ensures the balance between the environment and the inside of organism. Due to the pandemic, all members of the public are encouraged to frequently wash or disinfect hands, which may lead to skin irritation.

Aim. The aim of the study was to check the pH of soaps, skin care products and selected cosmetics used in the period of COVID-19 pandemic.

Materials and methods. For pH determination the CP-105 pH meter manufactured by ELMETRON® (Poland) was used. A total of 111 products available on the Polish market were collected for testing. The results were compared with the pH of tap water samples.

Results. The soaps had mean pH of 5.04 ± 1.04 , shampoos 6.04 ± 1.57 , creams 6.87 ± 0.1 , products for depilation 9.8 ± 3.06 . All the values were within legal ranges.

Conclusion. The majority of skin and hair cosmetics have pH close to the pH of tap water. Chemical hair removal products have the most alkaline pH and therefore, require extreme caution as they can cause irritation.

Keywords: soaps, skin care products, pH, COVID19 pandemic.

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INTRODUCTION

In human life cosmetics play the function of satisfying basic aesthetic, cultural and health needs. The word “cosmetic” comes from the Greek word ‘kosmētikós’ and literally means proficient at decorating. The definition of the word ‘cosmetic’ tells us that it is a product used for body and hair care used for beautifying them. Until today, the beauty of the human body is determined by well-groomed skin, hair, nails and teeth. Therefore, regardless of age, the aesthetic and well-groomed appearance, as well as healthy skin, facilitate social contacts [1]. In a Japanese study it was discovered that putting make-up improves women’s life quality [2].

Human skin is the outer cover of the body. It performs important functions for the entire organism such as protection of internal organs. The skin also protects the body against the effects of the external environment, ensures the balance between the environment and the inside of organism. Moreover, it also plays an important role in temperature regulation and water-electrolyte balance, in protection against mechanical, chemical, physical and bacterial factors, in secretory and resorptive activity, in the immune processes of the organism, in the metabolism of lipids, proteins, carbohydrates and vitamins, and also functions as a sensory organ [3]. The skin is made up of two layers: the epidermis and the dermis. Its thickness ranges

from 0.3 to 4 mm and depends on the area of the body, gender and age. The skin with the greatest thickness is found on the hands, soles, neck and back, and its total area reaches 2m². Skin pH ranges from 4.0 to 6.0 [4].

Numerous factors influence skin pH: age, anatomic site, genetic predisposition, ethnic differences, sebum, skin moisture, sweat, detergents, cosmetics, soaps, occlusive dressings, skin irritants, topical antibacterials [5]. Due to the COVID-19 pandemic, all members of the public are encouraged to wear face masks, keep social distance and wash or disinfect hands as often as possible [6]. Medical personnel has to perform hand hygiene before and after contact with each patient [7], wear gowns, respirators and gloves – personal protective equipment (PPE)[8]. However, there are recent publications about negative skin reactions to hygiene and use of PPE [6]. The most common adverse effect is allergic contact dermatitis and irritation dermatitis. Therefore, we have to use skin care products to restore the lipid layer protecting our skin.

AIM

The aim of the study was to check the pH of soaps and skin care products used in the period of COVID-19 pandemic.

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MATERIALS AND METHODS

For pH determination of samples collected, a CP-105 pH meter manufactured by ELMETRON® (Poland) was used. The pH meter was calibrated with buffer solutions at pH=4.00; pH=7; pH=9.

A total of 111 products available on the Polish market were collected for testing:

1. Tutti Frutti, Body Butter 'Pear and Cranberry'.
2. Bio Alterra body lotion with pomegranate oil.
3. HiPP, Familien - Bad, Family bubble bath.
4. Jardins de provence Vanilla & argan shower gel.
5. Nivea, smoothing body milk.
6. Johnson's, Shower Gel 'Watermelon and Rose'.
7. Nivea Universal cream.
8. Isana, Moisturizing and caring body cream 'Chia and Babassu Oil'.
9. Dove Nourishing Secrets Avocado Body Lotion.
10. LE PETIT MARSEILLAIS delicate shower gel with white peach and nectarine.
11. ORGANIC SHOP organic toning shower gel with Brazilian acai berries.
12. ISANA YOUNGHAPPY HEART Women's deodorant roll-on, floral freshness.
13. Johnson's, Shower Gel 'Watermelon and Rose'.
14. Isana, Deo Creme Sensitive, Cream deodorant for sensitive skin.
15. TUTTI FRUTTI body scrub Pear & Cranberry.
16. ISANA Body Lotion, Classic Soft.
17. ZIAJA nourishing body milk with cashmere.
18. VENUSUSE & GO mini moisturizing body lotion.
19. Joanna, Naturia Body, nourishing body balm with Olive Oil.
20. Vaseline Intensive Care Essential Healing Body Lotion.
21. Babydream extrasensitive care cream.
22. NIVEA MENSILVER PROTECT shower gel for body, face and hair for men.
23. ALTERRA Bio Sea Buckthorn shower gel and Bio Argan Oil.
24. Bepanthen Sensiderm Daily Care, cream.
25. BeBeauty, Japan, Sea algae shower gel.
26. Vaseline intensive care advanced repair, Body Balsam.
27. Evrëe Max Repair Body Lotion.
28. Dove Deeply Nourishing Nourishing Shower Gel.
29. AA VEGAN moisturizing bamboo body scrub.
30. APART NATURAL ACTIVE shower gel Free Man.
31. BeBeauty Creme, sweet maracuja creamy shower gel.
32. BABYDREAM care olive for children.
33. VEET hair removal cream sensitive skin.
34. Organic Shop Strawberry scrub - body detox.
35. ISANA INTENSIVE CARE conditioner for tired and damaged hair, Honey & Vanilla.
36. PETAL FRESH ORGANICS moisturizing hair conditioner grape seeds and olives.
37. Planeta Organica, Golden Ayurvedic hair mask.
38. Recipes of Grandma Agafia, Hair strengthening mask.
39. Biolaven, Hair conditioner with grape seed oil & lavender oil.
40. KALLOS COLOR Mask for colored hair.
41. Naturia - conditioner - Honey and lemon.
42. Green Pharmacy, Aloe, Balm for colored hair and other treatments.
43. Vianek, Pink Series, Anti-dandruff hair shampoo.
44. Garnier, Fructis, Grow Strong, Strengthening shampoo for weakened hair.
45. Head & Shoulders 2 w 1 - anti-dandruff shampoo with conditioner.
46. Schauma Shampoo 7 Herbs for normal and quickly greasy hair.
47. BingoSpa, strengthening shampoo 'Keratin and babassu oil'.
48. Herbal Care, Tar hair shampoo with dandruff.
49. Elseve, Total Repair 5, Regenerating conditioner.
50. Echosline styling volumizer volumizer spray.
51. Nivea repair & targeted care, a conditioning conditioner for dry and brittle hair.
52. Eveline, Argan + Keratin, Argan hair mask 8 in 1.
53. Joanna, Naturia, Conditioner with nettle and green tea for oily and normal hair.
54. ISANA MEN EXTRA POWER shampoo for normal hair.
55. Syoss, Silicone Free, Color & Volume, Conditioner for colored hair.
56. Blue, Aloe and Cucumber hair shampoo.
57. Syoss, Smooth Relax, Moisturizing and smoothing conditioner.
58. Isana, Professional, Oil Care, Conditioner for very damaged and dry hair.
59. Timotei Precious Oils Hair conditioner Precious oils.
60. JANTAR regenerative conditioner with amber extract.
61. DELIA CAMELEO keratin conditioner for extremely damaged hair.
62. ALTERRA shampoo for weakened and thinning hair, biotin & caffeine.
63. Cosnature, moisturizing rosehip shampoo.
64. ISANA STYLE 2 CREATE styling gel for hair that leaves no traces.
65. Schauma Fresh It Up! Shampoo.
66. HS Color Revitalizing Shampoo.
67. DELIA CAMELEO pink hair rinse.
68. AUSSIE 3 MIRACLE OIL RECONSTRUCTOR light oil for damaged hair.
69. STAPIZ Sleek Line Repair & Shine, Shampoo with silk for blonde, gray and bleached hair.
70. Stapiz Sleek Line Styling lotion Hair styling fluid.
71. Stapiz Sleek Line, Repair & Shine, Two-phase conditioner with silk.
72. O'HERBAL conditioner for dry and damaged hair with flax extract.
73. Under twenty 4 in 1 Micro Exfoliating Cleansing Gel.
74. Bielenda carbo detox Cleansing carbon gel for washing the face.
75. Garner clean skin, cleansing gel.
76. BIOLIQ 45+, firming and smoothing day cream.
77. BIELENDIA BOTANIC SPA RITUALS micellar water, turmeric + chia.
78. ZIAJA natural olive micellar water.
79. BOND SENSITIVE shaving cream for hard stubble.
80. ISANA MEN SENSITIV Mini shaving foam for sensitive skin.
81. ZIAJA COCOA BUTTER cream for normal and dry skin.
82. ZIAJA universal eye makeup remover.
83. NIVEA MENPROTECT & CARE 2in1 after shave for men.

84. NEUTROGENA VISIBLY CLEAR creamy face wash gel.
85. Avon Men, Rugged Adventure, Shaving Gel.
86. Avon Men, Rugged Adventure, After Shave Balm.
87. RIVAL DE LOOP nourishing face tonic for dry and sensitive skin.
88. RIVAL DE LOOPVITAL micellar water for sensitive skin.
89. Ziaja Green Olive Leaves, tonic with vitamin C.
90. La Roche Posay, Effaclar Duo [+], Cream that eliminates imperfections.
91. SYLVECO Thyme face gel.
92. Tolpa Green, Men, Cleansing gel-peeling for washing the face.
93. MAYBELLINE AFFINITONE foundation no.14 Creamy Beige.
94. Dermacol Make Up Cover. Covering face foundation.
95. Biotaniqe, DermoSkin Expert, Mineral gommage peeling 2 in 1.
96. EVREEMAX REPAIR regenerating foot cream for very dry and rough skin.
97. BeBeauty Care, Foot Repair, Deeply moisturizing foot cream.
98. Isana Lovely Winter, Cream soap with the scent of vanilla and tobacco flowers.
99. KIDS SHADOW Hand wash foam Banana adventure.
100. Isana, Mademoiselle Raspberry, Hand Cream.
101. LUXURY CREAMY Linen & Rice liquid soap.
102. Ziaja, Med, Ultra-moisturizing treatment Urea 10%, Hand cream.
103. EVREE TOTAL NUTRITION nourishing hand cream for very dry and sensitive skin.
104. SUN OZON CLASSIC sun milk SPF 30.
105. DAX SUN mattifying sun protection cream, SPF 30.
106. Dax Sun Transparent SPF30 ACTIVE + trige sunscreen.
107. VICHY IDÉAL SOLEIL Caring after sun milk.
108. ZIAJA INTIMA liquid for intimate hygiene with lactic acid.
109. VENUS mini intimate hygiene gel Aloe.
110. FACELLE INTIM aloe vera intimate wash.
111. Femina, Intimea, Creamy intimate hygiene lotion with lactic acid, prebiotics and betaine.

Mean pH values and standard deviation (SD) were calculated. The results obtained in each group of cosmetics were compared to the pH of tap water obtained at 10 taps within the premises of the Chair and Department of Hygiene of the Medical University of Lublin. In order to evaluate statistically significant differences between consecutive measurements, the ANOVA test was used; $p < 0.05$ was considered statistical significance. Statistical analysis was performed with the use of Statistica v.13.0 (StatSoft)(Statsoft Sp.zo.o.,Cracow, Poland).

RESULTS

The results are summarized in Table 1. All the values were within legal ranges.

Mean pH of water samples was 7 ± 0.1 . Products for depilation had statistically significantly higher pH than water ($p < 0.05$).

TABLE 1. The mean pH of examined cosmetics.

Group of products	pH (mean±SD)
For skin care	6.36±1.96
Body lotions	6.11±1.21
Shower gels	5.74±1.34
Deodorants	5.90±0.48
Body scrubs	6.95±0.66
For hair care	5.47±2.21
Shampoos	6.04±1.57
Masks, conditioners	4.75±1.1
For hair styling	7.31±1.17
For face	6.36±3.16
Washing gels	6.17±2.97
Face creams	6.31±1.21
Micellar fluids, tonics	5.98±1.88
Foundations	5.25±0.65
For feet	7.34±2.31
For hands	5.93±1.93
Soaps	5.04±1.04
Creams	6.87±0.1
For sunbathing/after sunbathing	7.13±0.66
For intimate hygiene	4.99±0.88
For depilation	9.8±3.06*

* $p < 0.05$ vs water samples

DISCUSSION

In pure water, the concentration of hydroxide and hydrogen ions are equal to each other and are:

$$[H^+] = [OH^-] = 1.00 \cdot 10^{-7} \text{ mol/l}$$

because from each water molecule one H^+ ion and one OH^- ion are formed. Due to the inconvenience of using such small concentrations, the decimal negative logarithm of the ion concentration is used, called as the pH of the solution:

$$pH = -\log [H_3O^+]$$

$$\text{therefore } [H_3O^+] = 10^{-pH}$$

therefore the pH of very pure water is

$$pH = -\log [H^+] = 7.$$

Likewise, we can calculate the pOH of pure water, which is the negative decimal logarithm of the concentration of hydroxide ions:

$$pH = -\log [OH^-] = 7.$$

By log the product of the ionic water, we obtain the following relation:

$$pH + pOH = 14 [9,10].$$

Solutions in which the concentration of hydroxide and hydrogen ions are equal are neutral, which means that their pH at a temperature of about 22°C is 7. Solutions with a concentration of hydrogen ions greater than the concentration of hydroxide ions are acidic, while solutions in whose concentration of hydrogen ions is lower than the concentration of hydroxide ions, have an alkaline reaction [11].

In our former study the mean (\pm SD) pH in soaps was 5.1 ± 0.8 (PJPH), creams and balms 5.9 ± 1.6 . [12]. In the present study it was similar: 5.04 ± 1.04 .

According to law regulations cosmetics must have pH:

- 3.0-8.0 – creams and lotions,
- 2.0-10.5 – soaps, shampoos, baths products,
- 3.0-8.0 – products for make-up removal [13].

According to Jaremek et al., 54% of students complain that wearing a mask had an impact on the occurrence of skin problems, such as acne. A similar number of respondents answered positively to the question about the influence of masks on their makeup [14]. Li et al. analyzed the negative health effects of wearing masks, goggles and respirators on medical personnel. They described: allergies, excessive skin hydration, local mechanical injuries, and even secondary infections [15].

CONCLUSION

The majority of skin and hair cosmetics has pH close to the pH of water. Chemical hair removal products have the most alkaline pH and therefore, require extreme caution as they can cause irritation.

REFERENCES

1. Molski M. *Chemia piękna*. Warszawa: Wyd. PWN; 2009. p. 2-26.
2. Shingyoji A, Tokumaru O, Ogata K, Yokoi I. Impact of makeup on quality of life of Japanese married couples: does makeup improve quality of life of wife as well as that of husband? *Gazzetta Medica Italiana – Archivio per le Scienze Mediche*. 2020;179(3):117-23.
3. Jabłońska S, Chorzeliski T. Choroby skóry dla studentów medycyny i lekarzy. Warszawa: Wyd. Lekarskie PZWL; 1994. p. 15-23.
4. Yosipovitch G, Maibach H. Department of Dermatology, UCSF Medical Center, San Francisco, CA, USA. *Skin Surface pH: A Protective Acid Mantle*. *Cosmetics & Toiletries Mag*. 1996;111(12):12-6.
5. Ali SM, Yosipovitch G. *Skin pH: From basic science to basic skin care*. *Acta Derm Venereol*. 2013;93:261-7.
6. World Health Organization. *Wytyczne WHO dotyczące higieny rąk w opiece zdrowotnej – podsumowanie*. World Health Organization; 2009.
7. European Centre for Disease Prevention and Control. *Wytyczne dotyczące noszenia i zdejmowania środków ochrony indywidualnej w placówkach opieki zdrowotnej w trakcie opieki nad pacjentami chorymi lub podejrzanymi o zachorowanie na COVID-19*. Sprawozdanie techniczne ECDC; 2020.
8. Duszyński J, Afelt A, Ochab-Marcinek A, et al. *Zrozumieć COVID-19. Opracowanie zespołu ds. COVID-19. Przy prezesie Polskiej Akademii Nauk*. Warszawa: Polska Akademia Nauk; 2020.
9. Kocjan R. *Chemia analityczna. Podręcznik dla studentów*. Tom I. Warszawa: Wyd. Lekarskie PZWL; 2002. p. 59-65.
10. Szmaj Z, Lipiec T. *Chemia analityczna z elementami analizy instrumentalnej. Podręcznik dla studentów farmacji*. Warszawa: Wyd. PZWL; 198. p. 45-6.
11. Minczewski J, Marczenko Z. *Chemia analityczna. Podstawy teoretyczne i analiza jakościowa*. Tom 1. Warszawa: Wyd. Naukowe PWN; 2001. p. 53.
12. Nieradko-Iwanicka B, Chrobok K, Skolarczyk J, Pekar J. What is the pH, Fe and Cl₂ content of cosmetics we use? – a pilot study on safety of skin care products. *Pol J Public Health*. 2017;127 (2):78-81.
13. Ustawa o kosmetykach z 30 marca 2001 r. o kosmetykach, Dz.U. Nr 42, poz. 473 z późn. zm., art. 2 pkt 1. [<http://isap.sejm.gov.pl/DetailsServlet?id=WDU20010420473> downloaded on Nov26th 2020]
14. Jaremek A, Chodun W, Piechnik J, Nieradko-Iwanicka B. The influence of wearing masks and gloves due to COVID-19 pandemic on skin problems and skin care in students of Medical University in Lublin. *J Educ Health Sport*. 2020;10(11):82-8.
15. Li C, Shen J, Ju Y, et al. Management and prevention of common skin problems during epidemic prevention and control of COVID-19. *Nan Fang Yi Ke Da Xue Xue Bao*. 2020;40(2):168-70.

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