Recommended by Doctor of Pharmacy, professor O.G.Bashura

UDC 687.5: 687,552: 661.185

DEVELOPMENT OF THE SHAMPOO FOR CHILDREN

L.S.Petrovskaya, O.V.Zhuk, I.I.Baranova

National University of Pharmacy

Key words: shampoo for children; detergent; foam cleaning base; foaming ability

Children, especially infants, have a sensitive and very vulnerable skin. Cosmetics for children supports the protective functions of the skin, making it less susceptible to a variety of stimuli. That is why children from the first days of life need other, safer skin care cosmetics than adults, it should not have the irritating action. In order to develop a foam cleaning product (shampoo) for children we have chosen a number of modern detergents of anionic, non-anionic and amphoteric character, such as 28% disodium laureth sulfosuccinate ("Euronaat LS 3", Disodium Laureth-3-Sulfosuccinate, "EOS", Belgium); cocamidopropyl betaine ("Cocamidopropyl Betain", "KAO", Japan); coco glucoside and glyceryl oleate ("Lamesoft PO 65", Coco Glucoside (and) Glyceryl Oleate, "BASF (ex-Cognis)", Germany); PEG-7 glyceryl cocoate ("Neopal LIS 80", PEG-7 Glyceryl Cocoate, "Industria Chimica Panzeri", Italy). Lactic acid was used as a pH adjustor. Based on these substances the foam cleaning bases in various concentrations of detergents have been prepared. The quality (physicochemical properties) of the foam cleaning bases developed has been assessed according to the current normative documents of Ukraine. At the first stage of the research it was determined that the use of "Euronaat LS 3" was irrational because it did not provide the required foam formation, hence, it was necessary to add other detergents. At the next stage the bases with addition of detergents with the low irritating effect, such as "Cocamidopropyl Betaine", "Lamesoft PO 65", "Neopal LIS 80", were studied to improve the physicochemical and consumer properties. It has been found that foam cleaning bases with additionally selected non-ionic and amphoteric detergents improved the properties of the foam cleaning base developed, namely the level and stability of the foam and its consumer properties increased. It should be noted that the bases developed were stable at the pH value selected (5.5-6.5).

The baby skin like all other organs develops gradually. And though at first glance it differs little from the adult's skin, it may take a lot of time before the baby's skin can fully perform all of its functions. Functions of the skin are diverse, but the main function is protective. This function in children is poorly expressed as evidenced by the easily vulnerable skin, frequent infections due to insufficient keratinization of the stratum corneum and its thinness, immaturity of the local immunity and intense blood supply. These peculiarities make the baby skin tender and prone to inflammation, in particular with poor care; that is why the skin care in children assumes daily hygiene and water procedures. Children, as well as adults, also need hair care. It is known that the skin of the baby's head does not yet contain special natural protective film, which adults have. That is why microbes and other harmful substances penetrate through the children skin faster than in adults. It is obvious that the products for the baby skin care must meet other criteria than the products for adults. Since the skin of a normal healthy child is capable to cope with its functions, the question of safety of cosmetic products should be considered first [4, 7, 10, 11].

The aim of our work is to create a foam cleaning base with safe detergents and based on it to develop a modern foam-cleaning agent for children.

Experimental Part

The study subjects were a number of modern detergents of anionic, amphoteric and non-ionic nature such as 28% disodium laureth sulfosuccinate ("Euronaat LS 3", Disodium Laureth-3-Sulfosuccinate, "EOS", Belgium); cocamidopropyl betaine ("Cocamidopropyl Betain", "KAO", Japan); coco glucoside and glyceryl oleate ("Lamesoft PO 65", Coco Glucoside (and) Glyceryl Oleate, "BASF (ex-Cognis)", Germany); PEG-7 glyceryl cocoate ("Neopal LIS 80", PEG-7 Glyceryl Cocoate, "Industria Chimica Panzeri", Italy). Lactic acid was used as a pH adjustor. Based on these substances the foam cleaning bases were developed in various concentrations of detergents [2, 12-16].

The quality of the bases developed together with the Pharmaceutical Research Centre "Beauty alliance", Kyiv was assessed according to the following indicators: appearance, organoleptic characteristics (colour, odour), determination of the pH value, foaming ability (foam number, foam stability). These indicators were considered for the qualitative assessment of modern foam cleaning agents according to DSTU4315: 2004 "Cosmetic products for cleaning skin and hair" and TU U24.5-31640335-002: 2007 "Products for skin care and cleaning".

The study of rheological indicators was carried out on a BROOKFIELD DV-II + PRO viscosimeter (USA) using a rotary adapter with the system of coaxial cylinders. The coaxial cylindrical geometry of the viscosimeter consists of a cylindrical spindle and a cylindrical camera, which provide precise measurement control of rheological parameters of Newtonian fluids [1, 3, 6, 8, 9].

The pH value level of the samples under study was determined by potentiometry (SPhU 1.2, 2.2.3) using a "pH Meter Metrohm 744" device (Germany).

Table 1

The study of the foaming ability of the base of disodium laureth sulfosuccinate

The concentration of disodium laureth sulfosuccinate, %	Foaming ability	
	Foam number, mm	Foam stability, c.u.
5.0	34.0	0.91
10.0	54.0	0.96
15.0	64.0	0.94

Results and Discussion

At the first stage the experimental samples of water solution of disodium laureth sulfosuccinate with the concentration of 5%, 10% and 15% were prepared. They were prepared at the room temperature at low speed of the mixer (20 rev/min) to prevent the formation of air bubbles. After complete dissolution of the detergent clear homogeneous liquid solutions without a specific odour were obtained. The pH value of these solutions was within 6.71-6.80, the standard rate of foam cleaning agents for children aged from 3 and older – pH 5.5 [5]. The pH was adjusted to the required value with lactic acid. The foaming ability and the foam stability were studied. According to DSTU 4315: 2004 the standard rate of foam number is not less than 145.0 mm, and the foam stability is 0.8-1.0 conditional units (c.u.).

As seen from the results (Table 1), the foam number was only 34.0 mm at 5% concentration of surfactants, and the foam stability index had a high value – 0.91 c.u. Both the foam number and the foam stability increased significantly in 10% solution of the surfactant. When the concentration increased up to 15%, the foam number reached the maximum and became 64.0 mm; at the same time, the foam stability was 0.94 c.u. Therefore, the conclusions can be made that this component should be used in the concentration of 10% since the solution has a relatively high value of the foam number and the highest value of the stability foam indicator.

It is irrational to use disodium laureth sulfosuccinate alone because it does not provide the required value of foam number according to DSTU 4315:2004. Based on the above experiment it has been proven that it is reasonable to introduce additional surfactants. Cocamidopropyl betaine was used as an additional surfactant. This is the most common surfactant used not only in development of products for children, but also in skin care products for adults. It is used to improve the foam level, stabilization of formulations, promotes cleansing properties, and in combination with some surfactants may contribute to the system's thickening. Its maximum recommended concentration is 12%.

At the next stage the required amount of 35% solution of cocamidopropyl betaine was added to 10% solution of disodium laureth sulfosuccinate at the room temperature. Cocamidopropyl betaine was completely dissolved within 5 min at the constant work of a mixer. It was added in the concentrations of 4%, 8% and 12%. The pH of solutions obtained was adjusted to 6.82 – 6.88 with lactic acid. As a result, transparent odourless liquid solutions were obtained.

Table 2

The study of the foaming ability of the base of disodium laureth sulfosuccinate and 35% solution of cocamidopropyl betaine

The concentration of 35% solution of cocamidopropyl betaine, %	Foaming ability	
	Foam number, mm	Foam stability, c.u.
4.0	56.0	0.91
8.0	85.0	0.96
12.0	90.0	0.95

As we can see from the research results (Table 2), the foam number increased in all samples, and foam stability of 4% and 12% solutions decreased, but the stability of 8% solution remained unchanged. Thus, the effective concentration of 35% solution of cocamidopropyl betaine is 8%, so the solution has a high foam number and the highest indicator of the foam stability.

The next step in development of the base is to stabilize the level of the foam. Coco glucoside / glyceryl oleate has been chosen as a foam stabilizer and a degreasing agent, its recommended concentrations for children care products is from 1% to 10%.

Since this surfactant is a concentrated substance, which is poorly soluble in cold water, 10% solution of disodium laureth sulfosuccinate with addition of 8% of 35% solution of cocamidopropyl betaine to it should be boiled previously to the temperature of 40-42°C. When rotating the mixer with 40 rev/min the amount of coco glucoside/glyceryl oleate required was added to the solution. This detergent was completely dissolved at the constant work of the mixer for 5-7 min. Thus, simultaneously five samples with the concentrations of 1, 2, 3, 4, 5% were prepared. As a result, a light yellow transparent odourless solution was obtained. The pH of the solutions obtained was 6.78-6.50; therefore, the pH value was adjusted to the desired value of 5.5 with lactic acid.

As can be seen from the results (Table 3), this component greatly improves the stability of the foam, but at higher concentrations coco glucoside/glyceryl oleate reduces the foam number more than twice from 123 mm to 66 mm because the foam becomes fine-grained and its volume decreases.

Table 3

The study of the foaming ability of the base of disodium laureth sulfosuccinate, 35% solution of cocamidopropyl betaine and coco glucoside / glyceryl oleate

The concentration of coco glucoside / glyceryl oleate, %	Foaming ability	
	Foam number, mm	Foam stability, c.u.
1.0	123.0	0.94
2.0	114.0	0.95
3.0	106.0	0.96
4.0	92.0	0.97
5.0	66.0	0.97

Table 4

The study of the foaming ability of the base of disodium laureth sulfosuccinate, 35% solution of cocamidopropyl betaine and glyceryl cocoate

The concentration of glyceryl cocoate, %	Foaming ability	
	Foam number, mm	Foam stability, c.u.
0.5	128.0	0.95
1.0	134.0	0.96
1.5	127.0	0.94
2.0	121.0	0.96

Table 5

The study of the foaming ability of the base of disodium laureth sulfosuccinate, 35% solution of cocamidopropyl betaine, glyceryl cocoate and coco glucoside / glyceryl oleate

Concentration, %		Foaming ability	
glyceryl cocoate	coco glucoside / glyceryl oleate	Foam number, mm	Foam stability, c.u.
0.5	0.5	138.0	0.95
1.0	1.0	142.0	0.96
1.5	1.5	139.0	0.94
2.0	2.0	131.0	0.96

Introduction of an additional foam stabilizer is rational.

Glyceryl cocoate was chosen as another foam stabilizer and another degreasing agent.

It was introduced to the base of disodium laureth sulfosuccinate and cocamidopropyl betaine previously heated on a water bath to the temperature of 40-42°C in the concentrations of 0.5%, 1%, 1.5%, and 2%. The surfactant was completely dissolved with the constant work of the mixer at 40 rev/m for 15 min. As a result, turbid liquid solutions without any odour and colour were formed. The pH of the solutions obtained was 6.90-6.95; the pH value was adjusted to 5.5 with lactic acid.

As can be seen from the results of the research (Table 4), this surfactant affects the level of the foam in this system, but not enough. The sample with the concentration of 1.0 % glyceryl cocoate has relatively high results (the foam number is 134.0 mm, the foam stability is 0.96 c.u.) compared to other samples.

Thereby, at the next stage both stabilizers were added in the foam cleaning base above selected in the ratio of 1:1.

10% Solution of disodium laureth sulfosuccinate was prepared, then 8% of 35% cocamidopropyl betaine was added. The resulting solution was heated on a water bath to the temperature of 40-42°C. At first coco glucoside / glyceryl oleate was dissolved, carefully stirred for 2-3 min. The component was visually checked for complete dissolution, then the required amount of glyceryl cocoate was added in the resulting solution, mixed thoroughly with a mixer of 40 rev/min for 2-5 min. At this time, the solution was cooled to a temperature below 35°C. The pH value of these solutions was within 6.67-6.85. Lactic acid was added, and pH was adjusted to 5.5. The study was conducted with the required number of the samples previously prepared. The solutions obtained were turbid, almost odourless and colourless.

As can be seen from the results of the research (Table 5), the combination of these foam stabilizers with the optimal concentration of 1% are functionally and economically advantageous for their use in this formulation.

CONCLUSIONS

A foam cleaning base with the complex of modern detergents has been experimentally developed. It has been proven that this base corresponds to physicochemical and consumer properties according to the necessary specifications and is a stable system at the pH value selected (5.5 – 6.5).

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РОЗРОБКА СКЛАДУ ШАМПУНЮ ДЛЯ ДІТЕЙ

Л.С.Петровська, О.В.Жук, І.І.Баранова

Ключові слова: *шампунь для дітей; детергент; піномиюча основа; піноутворювальна здатність*

У дітей, зокрема новонароджених, дуже чутлива і вразлива шкіра. Дитяча косметика підтримує захисні функції шкіри, робить її менш чутливою до різних подразників. Саме тому дітям з перших днів життя потрібна інша, ніж для дорослих, більш безпечна для догляду за шкірою косметика, яка не повинна чинити подразнюючої дії. З метою розробки піномийного засобу (шампуню) для дітей нами був обраний ряд сучасних детергентів аніонного, амфотерного і неіоногенного характеру: динатрію лауреатсульфосукцинат 28% («Euronaat LS 3», Disodium Laureth-3-Sulfosuccinate, «EOC», Бельгія), кокамідопропілбетаїн («Cocamidopropyl Betain», «KAO», Японія), кокоглюкозид і гліцерилу олеат («Lamesoft PO 65», Coco Glucoside (and) Glyceryl Oleate, «BASF(ex-Cognis)» Німеччина), ПЕГ-7 гліцерилу кокоат, («Neopal LIS 80», PEG-7 Glyceryl Cocoate, «Industria Chimica Panzeri», Італія). В якості регулятора значення pH використовували молочну кислоту. На основі цих речовин були приготовані піномийні основи у різних концентраціях детергентів. Якість (фізико-хімічні властивості) розроблених піномийних основ оцінювали згідно з прийнятою нормативною документацією України. На першому етапі дослідження встановлено, що використання «Euronaat LS 3» є нераціональним, оскільки він не забезпечує достатнього піноутворення, а значить потребує додавання допоміжних детергентів. На наступному етапі нами з метою покращення фізико-хімічних і споживчих властивостей досліджувалися основи, до яких додавали детергенти з низькою подразнюючою дією: «Cocamidopropyl Betain», «Lamesoft PO 65», «Neopal LIS 80». Було виявлено, що піномийні основи з додатково обраними амфотерними і неіоногенними детергентами покращили властивості розроблюваної піномийної основи: підвищився рівень і стабільність піни, а також її споживчі властивості. Необхідно відзначити, що розроблені основи були стабільними при обраному значенні pH (5,5-6,5).

РАЗРАБОТКА СОСТАВА ШАМПУНЯ ДЛЯ ДЕТЕЙ

Л.С.Петровская, Е.В.Жук, И.И. Баранова

Ключевые слова: *шампунь для детей; детергент; пеномоющая основа; пенообразующая способность*

У детей, в том числе новорожденных, кожа чувствительная и очень уязвимая. Детская косметика поддерживает защитные функции кожи, делает ее менее восприимчивой к различным раздражителям. Именно поэтому детям с первых дней жизни нужна другая, чем у взрослых, более безопасная по уходу за кожей косметика, которая не должна оказывать раздражающего действия. С целью разработки пеномоющего средства (шампуня) для детей нами был выбран ряд современных детергентов анионного, амфотерного и неионогенного характера: динатрия лауретсульфосукцинат 28% («Euronaat LS 3», Disodium Laureth-3-Sulfosuccinate, «EOC», Бельгия), кокамидопропилбетаин («Cocamidopropyl Betain», «KAO», Япония), кокоглюкозид и глицерила олеат («Lamesoft PO 65», Coco Glucoside (and) Glyceryl Oleate, «BASF(ex-Cognis)», Германия), ПЭГ-7 глицерила кокоат, («Neopal LIS 80», PEG-7 Glyceryl Cocoate, «Industria Chimica Panzeri», Италия). В качестве регулятора pH использовали молочную кислоту. На основе этих веществ были приготовлены пеномоющие основы в различных концентрациях детергентов. Качество (физико-химические свойства) разработанных пеномоющих основ оценивали согласно принятой нормативной документации Украины. На первом этапе исследования установлено, что использование «Euronaat LS 3» является нерациональным, поскольку он не обеспечивает достаточного пенообразования, а значит требует добавления вспомогательных детергентов. На следующем этапе нами с целью улучшения физико-химических и потребительских свойств исследовались основы, к которым добавлялись детергенты с низким раздражающим действием: «Cocamidopropyl Betain», «Lamesoft PO 65», «Neopal LIS 80». Было обнаружено, что пеномоющие основы с дополнительно выбранными амфотерными и неионогенными детергентами улучшили свойства разработанной пеномоющей основы: повысился уровень и стабильность пены, а также ее потребительские свойства. Необходимо отметить, что разработанные основы были стабильны при выбранном значении pH (5,5-6,5).