

Quality evaluation of non-medicated commercial shampoos for dogs in Mexico City

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Abstract

This work performed a descriptive analysis of the quality of shampoos for use in dogs that are marketed in Mexico City. Up to now, there is a lack of information in this regard, which is important to facilitate the selection and recommendation of these products by veterinary professionals. Products of 20 commercial brands were studied, to which physicochemical, sensory and performance tests were carried out, in addition to evaluating the content of their labels. The pH of the shampoos varied between 5.6 and 8.4; the viscosity, between 1 131 and 3 102 m Pa·s; the relative density, between 1.002 and 1.099 g/mL and the foam rate between 2.9 and 4.0 min. 95 % of the shampoos formed a closed foam, between 10 and 35 % of the brands presented deficiencies in the labeling. Generally, the physical-chemical and sensory properties of the shampoos brands under study are within the acceptable limits for the line of use in humans. However, the lack of consistency in labeling suggests that it is necessary to improve the supervision of applicable regulations to protect animals and public health.

Keywords: veterinary shampoo; quality control; sensory evaluation; performance evaluation; label.

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Additional information and declarations can be found on page 11

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Study contribution

The quality control of non-medicated shampoos for use in dogs helps to guarantee their safety and serves as a guide for the health authority to verify compliance with the regulations of these products. Unlike shampoos for human use, there is a lack of information on quality variables in non-medicated shampoos for dogs marketed in the country. This work provides reference values of physical-chemical, sensory, and performance attributes, which will allow the veterinary doctors and the owners or those responsible for the animals, to know and better select these products, as well as suggesting improvements in production to the commercial companies and manufacturing laboratories.

Introduction

Companion animals are increasingly considered an essential part of the family and have a positive impact on emotional well-being, which is reflected in the health of people, especially those whose only company is their dog.⁽¹⁾ A clean dog and well cared for is essential for the owners. There are various hygiene and beauty products for this species,⁽²⁾ with this activity, the industry that manufactures hygiene and beauty products for use in dogs generates jobs and economic growth. Still, these hygiene products are currently unregulated compared with their human-use counterparts, where processing companies are fined if they don't follow the claims or advertise false claims.

The function of the shampoo is to clean dirt and remove loose hair, excess oil and accumulated particles, which maintains the anatomical structure and prevents dryness of the skin and hair. Healthy hair has a hydrophobic surface to which lipids adhere, repels water. When the shampoo is applied to damp hair, it is adsorbed on the surface between the hair and the sebum. The anionic surfactants that form reduce surface tension and favor the elimination of sebum, the lipidic matter (apolar) emulsified and is eliminated with rinsing.⁽³⁻⁶⁾

The skin is an anatomical and physiological barrier between the body and the environment; protects from physical, chemical and microbiological damage.⁽⁷⁻¹⁰⁾ The pH of the skin influences the permeability of the skin barrier and normal keratinization processes. According to Proksch,⁽¹¹⁾ the average pH value in dogs is between 6 and 7, and varies according to the area of the body.^(12,13) Inadequate pH increases the susceptibility of the skin to harmful environmental factors.⁽¹⁴⁾

For this reason, it is expected that the shampoo has an adequate pH for the species for which it is intended, also that it forms abundant foam, it's easy to rinse, has adequate viscosity and does not irritate the eyes. The viscosity of the shampoo affects its performance as it should not run between the fingers of the person bathing the dog or the hair of the dog during washing. Additionally, the application of the shampoo must be simple and dispensing from its container must be adequate.⁽¹⁵⁾

Quality measurements (physicochemical and sensory characteristics) have been published in hygiene and beauty products for human use in several countries⁽¹⁶⁻¹⁸⁾ and in products for pets.⁽¹⁹⁾ However, quality measurements of products for pets have not been made in Mexico. In this country, the Ministry of Agriculture and Rural Development (SADER), through the National Animal Health, Safety and Quality Service (SENASICA), in an agreement published by the Official

Gazette of the Federation since 2018, exempted from regulation the chemical products for the hygiene and beauty of pets.

In this agreement, non-medicated products for animal use or consumption were deregulated—hygiene, beauty, perfumery, cosmetics and deodorants for administration in any physical state, topical application for skin and hair—.(20) However, these products must comply with other regulations related to the label claims described by the Mexican government.(21, 22)

This work evaluates the quality of pet shampoos marketed in Mexico City and compares the information published on the shampoo label with the official Mexican regulations, through a descriptive and comparative analysis of pet shampoos.

Materials and methods

Ethical statement

This research does not involve animals or people, so an ethics statement is not required.

Study design

This work studied the quality of 20 non-medicinal shampoos for pets marketed in Mexico City (CDMX) and the suburban area. The products were investigated by analyzing their physicochemical and sensory characteristics, performance tests and compliance with current regulations, including the information available on the product label.(21 – 23) All tests were performed in triplicate and at room temperature of $25^{\circ}\text{C} \pm 2^{\circ}$ The tests were carried out in the laboratory, using several strands of natural hair that were washed with the evaluated shampoos. As the purposes of this study are for analysis only, the names or trademarks of the products used are not reported.

Physicochemical tests

pH

A Mettler Toledo potentiometer was used. The use and calibration were performed according to the general methods of analysis (No. 0701).(24) The shampoo was diluted 1:10 with bidistilled water at pH 7.

Rheological evaluations

Viscosity

A Brookfield viscometer, model DV-II-trv, was used. Viscosity was measured according to the general methods of analysis (No. 0951).(24) Needles number 4 to 6 configured at different spindle speeds from 0.3 to 12 rpm was used.

Relative density

The analysis was carried out according to the general analytical methods (No. 0251).(24) A pycnometer and a balance were used. (OHAUS® Pioneer with an analytical precision of 0.0001 g).

The formula used to obtain the density is $\rho = m_1/m_2(\rho_2)$

Where:

ρ = density of the sample contained in the pycnometer;

m_1 : mass of sample contained in the pycnometer (g)

m_2 : mass of distilled water (or liquid of known density) containing (g)

ρ_2 : the density of the water (or liquid of known density) contained in the pycnometer.

Solubility

1-mL shampoo and 10 mL of deionized water were added to a beaker and stirred with a glass rod. Solubility was classified by visual observation.⁽²⁵⁾

Physical appearance, sensory test

Based on the visual observation of the samples, compliance with the following general conditions was verified: Appearance: transparent liquids must be free of sediments or particles; Products in emulsion, dispersion, or suspension form must be completely homogeneous with no visible signs of separation. The appearance was evaluated through the presence or absence of debris or sediment. Color homogeneity was evaluated by visual observations as homogeneous or heterogeneous. Pleasant or unpleasant parameters were used for the odor evaluation.^(26,27)

Performance tests in the laboratory

Quantity or index of foam

In a 10 mL test tube, 1 mL of distilled water and 1 mL of the shampoo sample to be tested were placed. The tube was capped and, after shaking for 2 min, the tube was placed at an angle of inclination of approximately 70 degrees. Foam formation was measured using a ruler at 1, 3, and 5 min.⁽²⁸⁾ The results were obtained using the formula:

$$\text{Foam index} = \text{foam height} / \text{total height}$$

Foam quality

Five milliliter of 1% shampoo solution was placed in a 10 mL test tube, covered with parafilm, and inverted at 180°C ten times. Total height and foam height were measured at 0, 3, 5, and 10 min. The shape of the bubble is observed and noted. The foam was considered better if it had a closed structure (there was no space between the bubbles), it lasted longer and could be easily rinsed. An open-structured foam had a space between each bubble that was wider.⁽⁷⁾ Therefore, the quality of the foam was evaluated through the following: "open" or "closed" type.

Detergency

The Thompson method was used to evaluate the detergency capacity of the samples: 5 g of wool fabric was placed in 100-mL water containing (20 mL of a 25% lanolin solution). Next, the cloth was placed in a 600 mL flask containing distilled water with 10 mL shampoo and shaken for 2 min at a rate of 50 times per minute. Finally, the cloth was dried and weighed.⁽²⁹⁾

Detergency was evaluated by measuring the amount of lanolin removed using the following equation:

$$DP = 100(1 - T/C)$$

where:

DP is the percentage of detergent power.

C is the weight of fat in the control sample.

T is the weight of fat in the test sample.⁽²⁹⁾

Disentangling

The test was carried out with several strands of natural hair, which were washed with the selected products. The ease of combing and detangling wet and dry hair was evaluated. Product performance was also rated for moisturization, silkiness, body, volume and shine through sensory observation.⁽¹⁶⁾ These performance tests were evaluated as a response (yes or no) to the question related to the evaluated variable.

Clearing

The shampoo's ease of rinsing of natural hair strands washed with the selected products was evaluated.⁽¹⁶⁾

Label review:

The information available to the user on the label of each product was analyzed to determine compliance with all required information: product specifications for animal use or consumption, indications for use, batch number, expiration date, country of origin, warnings of use and legend of veterinary use.^(21,22)

Statistic analysis data

Were analyzed using descriptive statistics (mean, standard deviation, minimum and maximum values, as well as relative frequency, for nominal variables).

Results

Physicochemical and laboratory performance tests

The pH value and viscosity were highly variable among the evaluated shampoos: the minimum and maximum pH values were 5.6 to 8.4, respectively; regarding viscosity, values of 1 131.15 to 3 102 were obtained. The average value of the relative density of the shampoos analyzed was 1.0342. Among the performance tests, the foam quality of non-medicated dog shampoos was evaluated: 19 of 20 products were of the "closed" type, which is deemed of better quality than the open bubble type. Only one shampoo showed open-type foam quality. All the products evaluated met the tests to determine detergency, detangling and lightening. Foam quality and detergency were similar between shampoos (Table 1). The results showed that the evaluated products passed the solubility tests (100%).

Table 1. Mean \pm standard deviation (SD) of the physicochemical and performance variables in commercial shampoos for dogs

Quality feature	Mean	SD	Minimum	Minimum
pH	7.3	0.7	5.6	8.4
Viscosity (m P a – s)	1 559.2	908.7	1 131	3 102
Relative density (g/mL)	1.034	0.030	1.002	1.099
Foam rate (min)				
0	2.9	0.4	2.0	3.5
3	3.1	0.5	2.0	4.0
5	2.9	0.5	2.0	4.0
Detergency (%)	93.3	1.78	90.2	90.7

Physical appearance, sensory test

All samples met the requirements for sensory tests that evaluated appearance, odor, and color. None of the samples presented residues, sediments or foreign particles, all showed a single phase and were completely uniform. Regarding the color, all the samples were homogeneous and pleasing to the eye. Regarding the smell, all the samples had a pleasant smell, according to the researcher's assessment.

Information on the labels of shampoos for veterinary use and their compliance with regulations

Based on label analysis, all tested products provided country of origin name and usage warnings. The indications (use, species, application) were not specified on the label in three of the analyzed shampoos. Two shampoos did not present the information to the public in Spanish. 10% of the shampoos did not show the lot number. Seven of the shampoos did not give an expiration date. Four of the shampoos did not have the legend "consult a veterinary doctor" established in NOM-012-ZOO-1993.

Discussion

This work presents an overview of the quality of non-medicinal pet shampoos that are marketed in Mexico City and surrounding areas. This research has been performed due to the fact that an evaluation of these products has not been published in Mexico, unlike other countries such as Venezuela,⁽¹⁹⁾ where some quality evaluation tests have been carried out and disclosed. The situation is different in Mexico for human shampoo, since the quality control of this product is evaluated by organizations such as the Federal Consumer Protection Agency,⁽¹⁶⁾ based on quality tests of products sold in Mexico. Results are published in print or digitally (in consumer magazines) to inform consumers of quality results and performance to help them select products for personal use.

Among the physicochemical tests, the pH value of shampoos is essential to minimize eye irritation and stabilize the ecological balance of the skin. Additionally,

the viscosity facilitates the diffusion of the shampoo on the hair, and the relative density of the product allows rapid and complete rinsing of the hair. According to the results: the relative density was not different between the shampoos. The pH values were different by three units, the lowest pH was 5.6 for shampoo 1 and shampoo 20 had the highest pH (8.4). The viscosity was variable, from 1 131 to 3 102 (Table 1). The pH of the shampoos for use in small animals, according to the literature, must have an adequate value with canine skin. Young et al.⁽³⁰⁾ mention that the pH can have values between 5.5 and 8.5, depending on the area of the body. Therefore, all the shampoos evaluated in this work were found within these values.

However, other authors reported that the pH of the skin varies according to the breed of the dog. So, for example, products with values of 5.6 to 6.8 are more suitable for the Springer Spaniel breed, and those with a pH of 8 to 8.4 are more suitable for the Siberian Husky and Manchester Terrier breeds.^(19, 31) Regarding the results found by Dlujnewsky in veterinary products marketed in Venezuela, it was found that 50% of the shampoos have a pH of 7, 30% of them have a pH of 8 to 10, and 16% have a pH less than 7 (with pH values of 6, 5 and 3).⁽¹⁹⁾

Our results showed that of the veterinary products marketed in Mexico City, 60% of the shampoos have a pH of 7, 25% have a pH of 8 to 8.4, and 15% have a pH less than 7 (6.8, 6.5 and 5.6). The pH of shampoos is important to minimize eye irritation and stabilize the ecological balance of the coat, so it is currently recommended that shampoos have a pH in line with that of the skin of the species to minimize damage to the hair, prevent swelling, promote hardening of hair scales and induce shine.^(32 – 34)

Veterinary shampoos should be specifically designed for the target species, products for human use should not be used, taking into account anatomical and physiological differences. These differences include the thickness of the stratum corneum (thinner), the pH of the skin (relatively more alkaline), since the pH in humans is between 4.1 and 5.8, and the density of hair follicles (higher), which they can facilitate the penetration of the active ingredients into the skin. On the other hand, Miller et al.⁽³⁵⁾ discovered that not all the products they evaluated met the pH of all dog breeds, since shampoos were found to have pH values > 8.3, while others had values of 5 or 6. The pH values agree with what was reported by Budreckiene et al.⁽¹⁾ who found values from 5.5 to 8.73. These results are also similar to the findings obtained in this paper also corroborates the present findings.

Due to the role of pH in the barrier function of the skin, the shampoos used in dogs should not cause an imbalance in the skin, increasing the susceptibility of the skin to harmful agents found in the environment.⁽¹⁴⁾ Rivers et al.⁽³⁶⁾ reported that the skin microbiota is influenced by the dog's pH, temperature, and grooming. To name a few, in healthy dogs *Staphylococcus pseudintermedius* is part of the skin microbiota. It colonizes the skin, the hair, and especially the mucocutaneous junctions, such as the nose, mouth, and anus. It is also an opportunistic pathogen, making up 90% of *Staphylococcus* isolated from healthy carriers and dogs with skin problems. Although *S. pseudintermedius* does not regularly colonize humans, transmission between dog and owner is possible. It has recently been described in several studies that it may pose a health risk. For this reason, it is important to maintain a shampoo with an adequate pH, mainly due to the rapid and recent appearance of resistant strains of bacteria.⁽¹⁾

The viscosity of shampoos is a critical characteristic that facilitates their spread on the hair. However, the viscosity of a liquid is not always constant and is usually related to other variables, such as temperature –the higher the temperature, the greater the fluidity; the lower the temperature, the more viscous.—⁽³¹⁾ Viscosity is a process test, and the product manufacturer determines the viscosity value according to its specifications.

All the veterinary shampoos evaluated were within the ranges published by Budreckiene et al.,⁽¹⁾ where values $\geq 3\,429$ are considered as high viscosity, $\geq 2\,710$ as medium value and < 92.5 as low viscosity. In the present work, only one shampoo had a viscosity value $> 3\,000$, 8/20 products had values $> 2\,000$ and 11/20 had a value $> 1\,000$. However, even the highest viscosity value did not present any difficulty to rub. For the values of 1 000, the shampoo did not present problems in any of the following aspects: being too liquid, increasing the amount of product required during the bath (detergency), running of the product between the fingers, greater use of water for rinsing (clarify), which leads to further environmental pollution and wasteful use of water.

Although there is no officially established value or range, the relative density should be as close as possible to the value of water = 1, which would lead to no difference between the density of water and that of shampoo. A relative density close to one allows a rapid and complete clarification of the product (rinsing).^(1,37) All the products evaluated fulfilled this aspect. In performance tests, particular attention was paid to brushability on both wet and dry hair, lathering, rinsing and detangling were also considered. Regarding detergency: all products met the requirements for dirt removal, removal of dust and grease particles, and rinsing.⁽¹⁾

Although foam generation has little to do with the cleaning ability of the shampoo, it is of the utmost importance to the consumer. Therefore, it is an essential criterion in its evaluation. Most of the shampoos evaluated showed similar antifoam characteristics in distilled water. In the foam index, most of the evaluated shampoos generated a good amount of foam; Regarding the quality of the foam, the majority of the products evaluated (19 of 20) formed a closed foam. Closed foam is considered to be of better quality (there is no space between the bubbles), more durable and easier to rinse, than open foam.⁽³¹⁾

Regarding the information on the product label, the notice of "Start of Operation" by the manufacturing company is governed by the *Federal Animal Health Law*:⁽²²⁾ Article 105 indicates that the owners of establishments that manufacture or sell these products for use in animals must give notice of the start of operation to SADER, within the following 15 calendar days. Three of the evaluated shampoos did not meet this requirement.⁽³⁸⁾ Regarding the Registration or Authorization, as indicated in NOM-012-ZOO-1993, "The national or foreign manufacturing company that is dedicated to the production of chemical products for use in animals, it must have the manufacturing authorization of the country of origin," three of the products evaluated did not present import data on their labels. Article 151 of the *Federal Law of Animal Health Regulations* establishes that chemical products for animal hygiene and beauty are regulated.^(23,29)

On the other hand, NOM-059-ZOO-1997 establishes that these products must have a registration or authorization number. According to the analysis of the label, all the products evaluated (100%) complied by providing the name of the manufacturing company and the name of the country of origin. These rules and regula-

tions are mandatory throughout the national territory and are intended to establish the guidelines that must be met by advertising material for chemical products, subject to registration.⁽²¹⁾

Regarding the advertising material of the label, the NOM-059-ZOO-1997 contemplates the specifications of products for use or consumption of animals. Likewise, section 4.3 indicates that the advertising material that is intended to be disseminated must be expressed in Spanish or, if it is in other languages, it must be translated into Spanish. In this area, only 90% of the products evaluated complied with the corresponding regulations.⁽²¹⁾ Having the manufacturer's instructions and specifications helps protect animal health, reduces risks to animal health and promotes safety. NOM-012-ZOO-1993, in its section 8.2.3, establishes that the use, species and application must be clearly expressed, and with commonly used terminology in the indications.⁽²³⁾ In this sense, 90% of the products evaluated complied with this information on their label.

In its article 3.27,⁽²³⁾ the previous regulation establishes that the lot number serves to identify all the documents related to the manufacture and control of the products. The same rule in Section 3.21 defines the batch number as a code that identifies any product that has been produced under equivalent operating conditions during a specific period. In this regard, 90% of the products evaluated complied with this information on their label.

Another piece of information that the label must have is the expiration date, which is the date assigned to a product that marks the end of its period of use. Products that lack this information do not comply with the legislation as this constitutes a health risk. Unfortunately, only 65% of the products tested had this information on their label.⁽²³⁾ Regarding the warnings of use, 100% of the analyzed products had information related to them,⁽²³⁾ which in numeral 8.24 (e) mentions that the indications of use, species and application must be presented in a clear and commonly used terminology. Failure to include these data poses a risk to the health and survival of companion animals, since the concentration is unknown. Additionally, the species for which the product is intended must be indicated.

The Legend "for Veterinary Use" is mentioned in article 8.22,⁽²³⁾ and specifies that veterinary products must bear the legend: VETERINARY USE; Article 8.24 b) also establishes that they must bear the label "CONSULT WITH A VETERINARY DOCTOR"; This is extremely important because we must differentiate the product for human use from that for pets to avoid confusion due to risks to human and animal health. Unfortunately, only 80% of the products presented this information.

Dog shampoos should be designed according to the characteristics of the species. Commonly, the owner uses human shampoo to bathe the dog. The shampoos and soaps used by humans are designed according to the typical pH of their skin. For this reason, if one of these products is used in another species, such as the dog, it can cause an imbalance in the skin, making the skin more susceptible to harmful agents in the environment.⁽⁶⁾

The dog skin is anatomically and physiologically different from human skin; it is less acidic, thinner and has a higher density of hair follicles than human skin.⁽³⁹⁾ Therefore, the pH value of canine skin differs from that of humans and tends to be higher than that of human skin. most other species mammals. According to Proksch,⁽¹¹⁾ the average pH value in humans is 4.1–5.8, and the pH of the skin in dogs is between 6 and 7. Additionally, in dogs, the skin is related to diseases

such as immune-mediated dermatoses such as pemphigus and lupus erythematosus;⁽⁴⁰⁾ the shampoo influences dryness, seborrhea, bacteria, enzymatic activity and circulation of the scalp.⁽⁴¹⁾ Therefore, shampoos must comply with quality control measures to avoid risks for the health of dogs.

Conclusions

The results show that the brands of non-medicated shampoo for dogs studied here have physicochemical and sensory characteristics similar to those of the shampoo for use in humans. The values reported in this work can serve as reference specifications for using shampoos in dogs. Alternatively, the lack of consistency in labeling, particularly regarding the expiration date and the veterinary use legend, suggests that it is necessary to improve the supervision of verifications or inspections to ensure compliance with sanitary standards to protect the animals and public health.

Data availability

All relevant data is found within the manuscript. The full set of data analyzed in this paper can be made available to readers upon request to the corresponding author.

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Conflicts of interest

The authors have no conflict of interest to declare regarding this publication.

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