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APPLICATION OF SENSORY EVALUATION TRIANGLE TESTS FOR QUALITY CONTROL OF LIQUID ANTACIDS

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ABSTRACT

The triangle difference test was applied to detect lot to lot variations in organoleptic properties in aluminum and magnesium hydroxides antacid suspensions from 22 lots prepared in different dates, with separation from 1 to 310 days. The panelists consisted of 10 to 17 trained judges, ages 18 to 24. Random samples were presented properly codified in six possible combinations. A total of 12 triangle tests was carried out and results were analyzed by the chi-square test in three significance levels (α = 0.05, α = 0.01 and α = 0.001). No significant differences in organoleptic properties (α = 0.05) were found in lots

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with difference in manufacturing date from 1 to 15 days, except in one test with a three day difference. There is at least significant difference in samples whose production date differs from 60 to 310 days and the frequency of finding significant, highly significant (α = 0.01) and very highly significant (α = 0.001) differences in sensory attributes increases as the difference in production date increases. Judges' observations referred mainly to texture of samples (viscosity and grittiness) to intensity of flavor and, with less frequency, to astringency and freshness. In most of the cases they assigned the more viscous perception to the older sample, except in one test (310 days), and the more intense flavor to the most recent lot. It can be concluded that sensory analysis and the triangle difference test can be successfully applied to detect variations in organoleptic properties in aluminum and magnesium hydroxides antacid suspensions. This fact can be used in quality control work and in establishing the shelf life of the product on the basis of deterioration of organoleptic properties.

INTRODUCTION

Patient acceptance of a drug, particularly oral medications, is a problem that the manufacturer must approach very seriously because of at least two main reasons (1). First, the therapeutic effect of the drug will only be achieved if the patient accepts the formulation from the standpoint of organoleptic attributes and complies with the treatment. Second, the commercial success of a prescription product depends greatly on patient acceptance. The latter is definitely true for OTC products, which are totally dependent on patient acceptance. Oral antacids, based on aluminum and magnesium hydroxides, are among the OTC drugs frequently used by patients of gastrointestinal diseases. One characteristic in the production of these medications, is that they are manufactured in large quantities (cubic meters per lot), making critical rigourous quality control of the product, which starts by careful selection of the raw materials for the formulation and establishing control points at different stages in the process. Typically, quality control of antacid formulations involves chemical, physicochemical and microbiological determinations. These tests will ensure the therapeutical potency and the microbiological safety of the preparation. However,

although the medication may be ideal from the pharmaceutical standpoint, it may be deficient from the point of view of patient acceptance. Thus, a different approach has to be taken to solve this problem. Sensory evaluation of the drug is a methodology which can be used effectively in product development and in detecting lot to lot variations in the product by taking into account patient acceptance considerations which include color, flavor, odor, size, shape, consistency and texture, portability, and ease of self-administration (1). Among these considerations, color, flavor, odor, consistency and texture are important organoleptic attributes which the patient perceives each time that he takes the prescription.

In general, for laboratory studies there are six types of tests that are used by sensory analysis (2): difference tests, rank order, scoring tests, descriptive tests, hedonic scaling and acceptance and preference tests. The triangle test is a difference test that can be used to determine true differences between three samples, two of them identical, it is one of the most extensively applied, studied and criticized of all test designs (2). The objective of this investigation was to apply the triangle test to detect lot to lot variations in aluminum and magnesium hydroxides antacid suspensions and to show how sensory analysis is used in quality control of oral pharmaceutical dosage forms.

MATERIALS AND METHODS

The samples used in this work belonged to different lots and were from a standard aluminum and magnesium hydroxides antacid formulation (4%, w/w, of each hydroxide), peppermint flavored and prepared commercially by a local manufacturer. The specimens were from 22 lots prepared in different dates, with differences from one to 310 days.

The triangle difference test was used to detect variations in organoleptic characteristics perceived by a panel of 10 to 17 trained judges, ages 18 to 24. The test consists in the presentation of three samples, two of them identical, to each judge, the judge is told that one of the samples is different and is asked to identify it. This method is very useful in quality control of foods to ensure that there are no significant organoleptic differences between samples from two different lots (3). Analysis of the results of

triangle tests is based on the probability that if there is no significant difference, the odd sample will be selected by chance alone one third of the time. As the number of judgments increases, the percentage of correct responses required for significance, decreases. For this reason, when only a small number of panelists are available, they should perform the triangle test more than once in order to obtain more judgments.

The panelists were selected from a group of 30 candidates and were chosen because they were able to detect differences between samples of the antacids as test stimuli and also because of their manifested interest in the project and responsibility to attend the selective sessions. The selected panelists were trained to disregard personal preferences and to understand the correct form to carry out sensory evaluation tests and, particularly, to test aluminum and magnesium hydroxides antacid suspensions. Training consisted in two kind of tests: 1) determination of umbral concentration in three (salty, sweet and sour) of the four basic flavors; 2) perception of flavor differences and texture (viscosity). The panelists were also instructed in and agreed upon the exact connotation of each descriptive term used to characterize the samples, Table 1.

The judges were asked to test each sample in such a way as to impregnate the tongue fully and perceive the flavor and texture; afterwards, the judge should discard the sample, rinse his mouth thoroughly with water and rest for a moment before testing the next stimuli. They were also asked to write down any relevant observations according to the descriptive terms when they assumed it was important. The judges were told that two of the samples were the same and one different, and were requested to identify the odd sample. Sensory evaluation tests were performed in a well illuminated area (natural light) and free from any odors which could interfere with the tests.

A total of 12 triangle tests were carried out. In each test, two different lots (A and B) of the same antacid suspension were analyzed. The samples were presented randomly and properly codified to the judges in the six possible combinations for a triangle test: AAB, ABA, BAA, ABB, BAB and BBA. In order to avoid flavor detecting fatigue, the stimuli were presented to the judges in two sessions: three in the first session and the rest in the second. Results were analyzed by the chi-square test in three significance levels (α=0.05, 0.01 and 0.001).

TABLE 1

TERMS USED TO CHARACTERIZE SENSORY PERCEPTION

Flavors	Texture	Others
Sweet	Hard	Astringency
Salty	Elastic	Pungency
Acid	Gritty	Flavor intensity
Bitter	Humid	Freshness
Special flavors	Soft	Numbness
	Viscous	

RESULTS AND DISCUSSION

Results from the application of the triangle difference test to twenty two lots of the antacid formulation can be seen in Table 2. Tests number 2, 3, 9, 10 and 11 have a smaller number of choices presented to the judges because after performing the first session of three sample combinations, results showed at least significant difference (α=0.05) and the second session was suspended. Test number 9 compared three lots instead of two as in the other tests, however lots 305580 and 305605 used in this test, showed no significant difference between them (α=0.05), as can be seen in test number 7, so these two lots were considered as one single sample for this test. The number of choices for Test 9 is smaller than the rest of the tests because samples from the two lots, 305580 and 305605, were used in Test 7 and the amount of sample left was not enough to carry out the second session of tests. This fact is not expected to affect the conclusions, as will be seen later.

In general, no significant organoleptic differences were found for lots manufactured in consecutive days, Tests 1 and 5, neither was found for lots prepared within 3, 5, 15 and 45 days difference, except for the lots in Test 8, although no explanation was found for this case. All tests carried out with lots that have differences in manufacturing date from 60 to 310 days show at least significant organoleptic

TABLE 2

TRIANGLE TEST ON ALUMINUM AND MAGNESIUM HYDROXIDES ANTACID SUSPENSIONS, PRODUCED IN LOTS WITH DIFFERENT PRODUCTION DATES.

Test No.	Lot No.	Differece in production date, days	Correct choices/ Choices	Result*
1	301121 301130	1	29/64	NSD($\alpha = 0.05$)
5	302254 302255	1	37/96	NSD($\alpha = 0.05$)
4	302234 302235	2	39/102	NSD($\alpha = 0.05$)
8	305604 305622	3	34/75	SD ($\alpha = 0.05$)
6	305573 305578	5	35/90	NSD($\alpha = 0.05$)
7	305580 305605	5	23/69	NSD($\alpha = 0.05$)
12	305671 306723	15	29/84	NSD($\alpha = 0.05$)
9	303420 (305580- -305605)	42-45	15/39	NSD($\alpha = 0.05$)
2	212132 302201	60	24/51	SD ($\alpha = 0.05$)
11	303398 305675	66	34/42	HSD($\alpha = 0.01$)
10	303348 305672	85	23/42	HSD($\alpha = 0.01$)
3	203244 302201	310	39/45	VHSD($\alpha = 0.001$)

*NSD: no significant difference between samples; SD: significant difference; HSD: highly significant difference; VHSD: very highly significant difference.

differences between them. The data indicate a trend to deteriorate the sensory attributes of the antacid formulations as the storage time increases and thus, the frequency of finding significant (α=0.05), highly significant (α=0.01) or very highly significant (α=0.001) differences between lots, increases. In this sense, it would be possible by using triangle tests, to detect when the product becomes distasteful and is rejected by the judges. These tests would eventually establish the shelf life of the formulation from the point of view of patient acceptance. Incidentally, chemical, physicochemical and microbiological stability of aluminum and magnesium hydroxides antacid formulations are not a significant problem for most manufacturers of this product and thus, shelf life determination of these antacids should consider patient acceptance of the formulation.

It is important to note that results of triangle tests indicate whether or not there is a detectable difference between two samples. Higher levels of significance do not indicate that the difference is greater, but that there is less probability of saying there is a difference when in fact there is none.

Judges' observations referred mainly to texture of samples: viscosity and grittiness, to a particular perception related with intensity of flavor and, with less frequency, to astringency and freshness. In most cases, they perceived higher viscosities in older lots, except in Test number 3 (310 days), and the more intense flavor among the most recent lots.

CONCLUSIONS

From the results presented here, it can be said that application of triangle difference tests was successful in detecting differences between lots of different production date. The frequency of detectable sensory perception difference between lots increased as time of production between them was longer. There was no detectable difference between lots one to fifteen days apart, but the situation changed when lots were produced with two-month difference or more, then, detectable perception difference was more frequent. These results also indicate that sensory analysis for aluminum and magnesium hydroxides antacid suspensions is a useful methodology for quality control, since they indicate differences between sensory perceptions when they exist. This fact can be used too to establish

shelf life for this kind of products and, indeed, for any oral dosage form.

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