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Flavor Selection for an Aluminum and Magnesium Hydroxides Antacid Suspension

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ABSTRACT

The organoleptic properties of a formulated oral liquid drug are an important feature that has to be considered by the manufacturer for patient acceptance of the medication and, particularly, for the commercial success of over-the-counter (OTC) products. In this work we report the results of using techniques on sensory evaluation to establish a methodology useful to help the manufacturer to select a particular flavor for a formulation oriented to the occasional consumer of antacids. Four differently flavored formulations prepared from a standard base of aluminum and magnesium hydroxides antacid suspension were tested by a panel of nine judges (ages 20–34) trained in the method and in the sensory characteristics of the product. Tests were carried out using natural light and repeated with red light, since color of samples can bias the panelists' decision for a preferred flavor. In both cases a ranking test with a 1–4 scale (1 most preferred; 4 least preferred) was used to determine panelist preference. The test was carried out six times on different days. Multiple comparison tests and analysis of variance of the

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results showed that the order of preference for flavors using natural light was strawberry, spearmint, peppermint, and orange, with a highly significant difference ($\alpha = 0.01$) between strawberry and orange, and a significant difference ($\alpha = 0.05$) between spearmint and orange. With red light illumination, the order of preference remained the same, but there was a very highly significant difference ($\alpha = 0.001$) between strawberry–orange and strawberry–peppermint, and between spearmint–orange; and a highly significant difference ($\alpha = 0.01$) between spearmint–peppermint and peppermint–orange. The results indicate that flavor for an aluminum and magnesium hydroxides antacid suspension can be selected by using standard sensory evaluation techniques and illustrate the importance of using red light to avoid biasing of the judges in determining flavor preference.

INTRODUCTION

Patient acceptance of a liquid oral dosage form is an issue that the manufacturer should consider very seriously for the commercial success of the formulation, and yet only a few reports on the organoleptic properties of drugs appear in the published literature (1–8). Aluminum and magnesium hydroxides antacid suspensions are among the over-the-counter (OTC) oral liquid drugs frequently used by patients of gastrointestinal diseases. In recent years, an increasing number of flavors of standard antacid formulations have been available on the shelves of drugstores and supermarkets, giving the consumer the opportunity to select his(her) favorite flavor. However, from the standpoint of organoleptic characteristics, it has been recognized that certain flavors become monotonous if they have to be taken daily, and sometimes several times a day, for extended periods of time, as would be the case for an intensive antacid therapy. It is thought that less exotic flavors, such as peppermint, might be best for these kinds of products (6). Thus, besides satisfying the USP specifications for aluminum and magnesium hydroxides antacid suspensions (9), two problems seem evident from this rationale: on the one hand, for the occasional user of antacids, a variety of flavors should be available so that he(she) can select the most pleasant to his(her) taste, and therefore, the manufacturer faces the problem of selecting several flavors to satisfy the demand and taste of different groups of consumers. On the other hand, for the consumer who is in therapy because of a gastrointestinal condition with aluminum and magnesium hydroxides antacid suspensions, the manufacturer should have available flavors which can be accepted by the patient, particularly if he(she) is to take the formulation for extended periods of time.

Besides flavor, other organoleptic characteristics are of interest, such as color, texture, palatability, and odor. It has been reported (10,11) that color interferes significantly with flavor preference: when flavor tests are performed, an offensive color can be associated subconsciously with an unpleasant flavor or texture and the judges' answers are related with these properties.

In this work, we report the results of using techniques on sensory evaluation to establish a methodology useful in helping the manufacturer select a particular flavor for a formulation aimed to satisfy the occasional consumer of antacids. However, this procedure can also be used to establish the preferred flavor for the consumer who is to take this type of medication during extended periods of time.

MATERIALS AND METHODS

The samples used in this work were from a standard base aluminum and magnesium hydroxides antacid formulation (5%, w/v, of each hydroxide and 0.8%, w/v, of dimethylpolysiloxane) prepared so that added flavors were as presented in Table 1 for each sample. Strawberry flavor (M-5 concentrated liquid flavor in an alcoholic base) and peppermint (30-5310 artificial liquid essence in an alcoholic base) were from Haarman and Reimer, S.A. de C.V. (Mexico City); orange (AMX-0316 flavor essence) and spearmint (AMX-06724 spearmint flavor) were from Mané de México, S.A. (Mexico City). The concentrations per liter of each flavor used to prepare the formulations were selected by the laboratory staff as recommended by the manufacturers. Strawberry and orange flavors were pink and orange colored and so were the resulting antacid formulations, Table 1.

The evaluation panel was formed by nine judges (ages 20–34) trained in the method and in the sensory characteristics of the product. The panelists were se-

Table 1

Flavor and Color of Samples

Sample	Flavor	Concentration in Formulation, g/L	Resulting Color
1	Spearmint	1.00	White
2	Strawberry	1.25	Pink
3	Orange	2.00	Orange
4	Peppermint	1.50	White

lected from a group of 16 candidates (ages 18–34) taking into consideration their ability to detect sweet, salty, and bitter flavors at low concentration and on the basis of their manifested interest in the project and responsibility to attend the selective sessions. Details on the selection and training of the judges are reported elsewhere (1).

Tests were performed using natural light and repeated with red light, since color of samples can bias the decision of the panelists for the preferred flavor (10,11). In both cases a ranking test was used to determine panelists preference for one of the flavors in Table 1. The test consisted in presenting to each judge duplicate series of samples, one of each flavor, randomly and properly codified. The samples were presented in white plastic 10 ml cups that presented neither color nor flavor which could bias panelist's preference for a given flavor. The judges were instructed to taste the first sample in such a way as to impregnate the tongue completely, then discard it and rinse his(her) mouth thoroughly before tasting the following sample. The panelists wrote the ranking codes on an answer sheet: 1 below the code number of the most pleasant sample, and 2, 3, and 4 to indicate the second, third, and fourth in preference (12). Results were analyzed by the multiple comparison procedure proposed by Joannes (13). The test was carried out six times on different days to make up for the limited number of panelists. Analysis of variance of the results was carried out considering flavor and experimental error as the sources of variation.

RESULTS AND DISCUSSION

The results obtained from the ranking test using natural light are presented in Table 2, where it can be seen that the judges preferred the strawberry flavor (smallest value of sum of squares) whereas orange flavor was the least preferred (highest value of sum of squares).

Analysis of variance, Table 3, indicates that there is significant difference between samples, considering samples as the only source of variation.

Table 4 shows that strawberry flavor is preferred over orange flavor with high significance ($\alpha = 0.01$). Additionally, spearmint is preferred over orange although to a level of significance of 0.05. No other pair of samples has a significant difference in preference at a level of $\alpha = 0.05$.

Table 5 shows the results of the sum of ranks obtained from the ranking test using red light to mask the color of the samples. As can be seen, judges preferred strawberry flavor over the others, and orange flavor was the least preferred.

Analysis of variance of the results with red light, Table 6, indicates that there is a significant difference between samples at a level of significance of $\alpha = 0.01$, and in Table 7 it can be observed that there is a very highly significant preference ($\alpha = 0.001$) of strawberry over orange and peppermint flavors, and of spearmint

Table 2

Sum of Ranks in the Preference Test Using Natural Light

Test	Strawberry	Spearmint	Peppermint	Orange
1	42	44	36	58
2	41	35	54	50
3	37	40	56	47
4	33	52	45	50
5	39	42	43	56
6	54	44	40	42
Sum	246	257	274	303
Average	41.00	42.83	45.67	50.50
SD	7.13	5.60	7.86	5.86

Table 3

Analysis of Variance: Preference Test Using Natural Light

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Computed *F*
Flavors	3	24,762	8,254	7.01**
Error	20	23,562	1,178	
Total	23	1,200		

**Highly significant difference ($\alpha = 0.01$).

Table 4

Minimum Significant Differences: Preference Test Using Natural Light

Flavor	Orange	Peppermint	Spearmint
Strawberry	57**	28	11
Spearmint	46*	17	
Peppermint	29		

*Significant difference ($\alpha = 0.05$).
**Highly significant difference ($\alpha = 0.01$).

over orange flavor. Additionally, there is a highly significant preference ($\alpha = 0.01$) of spearmint over peppermint flavor, and of peppermint over orange flavor; however, there is not a significant preference ($\alpha = 0.05$) of strawberry over spearmint flavor.

In this work it was observed that color of samples biases panelists' decision for a preferred flavor. If results from the preference tests using natural and red lights are compared, it can be seen that they differ greatly. Whereas there is significant difference only in two cases in the preference test using natural light, this difference is presented in five cases in the test with red light. Since the tests were carried out one (red light) immediately after the other (natural light), the only difference between them is the kind of light used: it is evident that the color of the sample affects flavor preference decision from the judges. The influence of color on preference for a given product has been observed and it is well documented in sensory evaluation of foods (10–12).

As far as the age group used in this study is concerned, it has been reported (Ref. 14, cited by Amerine et al., Ref. 11) that a decrease in taste sensitivity is less notorious in people 20 to 30 years old. In this study the panelists age was between 20 and 34 years, and thus it is not thought that age variation in the group could affect the results. Additionally, for analytical judges, as those participating in this study, it is recommended they be chosen from the age range between 18 and 50 years

Table 5

Sum of Ranks in the Preference Test Using Red Light

Test	Strawberry	Spearmint	Peppermint	Orange
1	34	47	40	59
2	34	42	54	50
3	36	35	52	57
4	36	38	50	56
5	42	35	43	60
6	38	40	44	58
Sum	220	237	283	340
Average	36.67	39.50	47.17	56.67
SD	3.01	4.59	5.60	3.56

Table 6

Analysis of Variance: Preference Test Using Red Light

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Computed *F*
Flavors	3	1,443	481	25.93**
Error	20	371	18.55	
Total	23	1,814		

**Highly significant difference ($\alpha = 0.01$).

Table 7

Minimum Significant Differences: Preference Test Using Red Light

Flavor	Orange	Peppermint	Spearmint
Strawberry	20.00***	10.50***	2.83
Spearmint	17.17***	7.67**	
Peppermint	9.50**		

**Highly significant ($\alpha = 0.01$).
***Very highly significant ($\alpha = 0.001$).

since their physiological and cultural development is optimum (12).

CONCLUSIONS

From the data obtained in this work, it can be concluded that strawberry was the favorite flavor for a standard aluminum and magnesium hydroxides antacid suspension, with no significant difference from spearmint flavor, and that these flavors were preferred over peppermint and orange. When color of samples is considered, strawberry and spearmint flavors were significantly preferred over orange flavor but not over peppermint flavor.

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