

# The use of flavor in cigarette substitutes

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Cigarette smokers identify flavor as an important factor in the pleasure derived from smoking and for their choice of cigarette brand. The issue of cigarette flavor has received a great deal of study by cigarette manufacturers but relatively little by academic investigators. The paucity of literature is particularly acute in terms of the importance of flavor in cigarette substitutes, which are used to help people to reduce or quit smoking. In the current study, five different types of flavors added to a plastic cigarette substitute were assessed in experienced smokers. There were two menthol-like flavors and three tobacco-like flavors. Two groups of smokers were tested: menthol smokers and "regular" (non-menthol) smokers. Both types of smokers liked the two menthol flavors significantly more than placebo and rated the menthol flavors and the cigarette flavor as significantly more satisfying than placebo. Craving was differentially reduced in the two groups of smokers. Menthol smokers showed a small reduction in craving with the placebo, with a significant enhancement of this reduction seen with the addition of the "EZ Quit" menthol flavor.

**Key words:** flavor; cigarette substitutes; tobacco; cigarettes; smoking; smoking cessation; menthol

## Introduction

The importance of flavor in cigarette smoking is evidenced by the effort and expense that tobacco companies invest in analyzing, developing and advertising the different flavors of their cigarettes. For example, one of the most widely known cigarette advertising slogans in recent times is "*Winston tastes good like (sic) a cigarette should*". Cigarette smokers identify a wide variety of flavor and aroma components as important in the pleasure they derive from smoking (Reasor, Reynolds and Ferris, 1988). However, in contrast to cigarettes, little research has been conducted concerning the importance of flavor in cigarette substitutes that may be employed in smoking cessation programs. Since the flavor of cigarettes is so important to smokers, it seems reasonable that

the flavor of cigarette substitutes would be important as well. Developing proper flavors for cigarette substitutes might help their efficacy for aiding the reduction and cessation of cigarette smoking.

As with cigarettes, there is probably no single flavor that is preferred by all individuals using a cigarette substitute. The most pronounced difference in the flavors between cigarette brands exists between the mentholated and "regular" (i.e., non-mentholated) brands. In the present study, cigarette substitutes using five different flavors were assessed by experienced smokers of either menthol or regular cigarette brands.

The chemosensory cues provided by cigarette smoke as it passes through the upper respiratory tract on its way to the lungs may become important for the reinforcing effects of cigarette smoking (Ashton and Stepney, 1982; Cain, 1980; Stepney, 1984). We have found that the sensory stimuli accompanying cigarette smoking are crucial in providing much of the

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immediate satisfaction gained from smoking. Especially important is the tracheal "throat scratch" provided by cigarette smoke (Cain, 1980, Rose, 1988; Rose et al., 1984; Rose et al., 1985). A cigarette substitute which provides a throat scratch effectively reduces craving and is rated as more satisfying by smokers than one that does not (Rose and Hickman, 1987). The present study was conducted to determine whether the addition of flavor to cigarette substitutes would also enhance the degree of satisfaction and craving reduction they provide.

## Methods

### Subjects

Twenty-five experienced smokers (20 male, 5 female) recruited by newspaper advertisements in the Los Angeles area were the subjects in the present study. Thirteen smoked "regular" (non-mentholated) cigarettes while 12 smoked menthol cigarettes. Their average age was 37.7 years (range 21–65) and they had been smoking cigarettes regularly for an average of 17.3 years (range 5–50). They smoked an average of 26.6 cigarettes per day (range 20–45) with an average nicotine delivery of 1.02 mg (range 0.61–1.14) as determined by the standard FTC method. There were no significant differences in these smoking characteristics between the groups of regular and menthol smokers.

### Procedure

The subjects participated in the study between 0900 h and 1230 h after undergoing overnight deprivation of cigarettes. The subjects were given placebo cigarettes made of a hollow plastic tube with a flavor capsule loaded inside (Fig. 1). Five different flavors and a placebo (no flavor) were used. Three of the flavors were tobacco-like and two were menthol-like. The added flavors were: the smoke residue from a mechanically smoked cigarette (Pall Mall) and two natural liquid flavor mixtures often added to tobacco, "T77" flavor (Type T 7739) and "Virginia" flavor (Type 77696–74), both made by Givaudan Inc. (Clifton, NJ). The

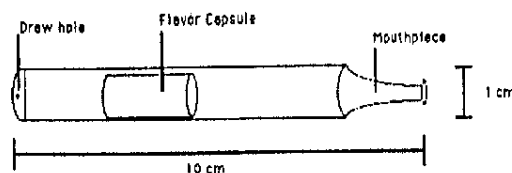


Fig. 1. A diagram of the plastic smoking substitute device.

liquid flavors were added to cigarette filters inserted into the plastic cigarette substitute. The device used was identical in all conditions; only the flavor differed. The cigarette smoke residue was adsorbed to the surface of the chamber by passing smoke from one cigarette through it. The menthol flavors used were the cartridges used in two commercial smoking cessation products: EZ-Quit (Tarzana, CA) and Paipo (Tokyo, Japan). One of the major constituents in these products was menthol, but they also contained mint and other flavors. In a repeated measures design, each of the subjects was given the six flavors, one at a time, for 30 min each in a counterbalanced order in one day. They were told to try each of the substitutes by puffing on it when they received it and to continue to use it ad libitum for the next half hour.

After testing each device the subjects were asked to fill out a questionnaire to rate it on seven point scales ranging from very definitely not (1) to very definitely (7). The questions were:

- "Did it reduce your craving for a cigarette?"
- "Did you like it?"
- "Was it satisfying?"
- "Did you puff on it more than you would have puffed on a cigarette?"
- "Would it help you to quit smoking?"

After testing all of the devices the subjects were asked to rank them from the most to least favorite.

### Data analysis

The subject ratings were evaluated by a mixed design analyses of variance for between

and within subjects measures. The between subjects factor was menthol vs. non-menthol (regular) smokers and the within subjects factor was the cigarette substitute flavor condition. Significant interactions were followed-up by tests of the simple main effects of flavor within each group to determine the source of the interaction (Keppel, 1973). To further evaluate significant flavor effects, planned comparisons using the Bonferroni correction for alpha slippage (Neter, 1985) were made for each of the flavor conditions with the placebo condition.

## Results

### Liking

There was a significant main effect of flavor ( $F(5, 115) = 7.07, P < 0.001$ ). However the main effect of group and the group  $\times$  flavor interaction were not significant. As shown in Fig. 2, significant increases in liking were seen only with the EZ Quit ( $P < 0.05$ ) and Paipo ( $P < 0.05$ ) conditions compared with placebo. The three tobacco flavors were not found to be effective with this measure.

### Satisfaction

There was a significant main effect of flavor ( $F(5, 115) = 6.84, P < 0.001$ ). No significant effects were seen with the main effect of group or the group  $\times$  flavor interaction. As shown in Fig. 3, significant increases in satisfaction were seen with EZ Quit ( $P < 0.01$ ), Paipo ( $P < 0.05$ ) and the cigarette flavor ( $P < 0.01$ ).

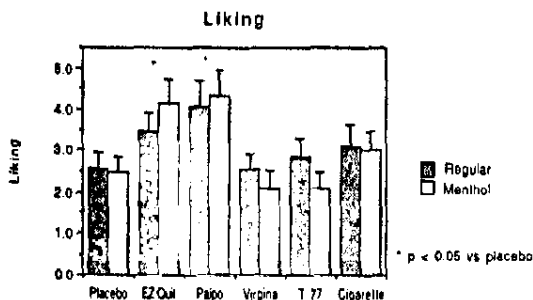


Fig. 2. The effect of flavor condition on "liking" ratings by regular ( $N = 13$ ) and menthol ( $N = 12$ ) groups (mean  $\pm$  S.E.M.).

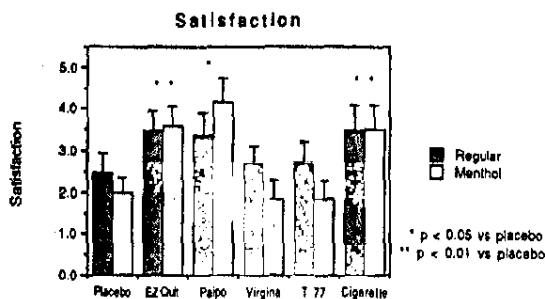


Fig. 3. The effect of flavor condition on "satisfaction" ratings by regular ( $N = 13$ ) and menthol ( $N = 12$ ) groups (mean  $\pm$  S.E.M.).

### Craving reduction

There was a significant overall effect of flavor on craving reduction ( $F(5, 115) = 3.16, P < 0.01$ ). There was no significant main effect of group. The group  $\times$  flavor interaction was significant ( $F(5, 115) = 2.99, P < 0.025$ ). Different flavors added to the cigarette substitute improved the craving reduction for the regular group versus menthol group (Fig. 4). As a follow-up statistical analysis to determine the

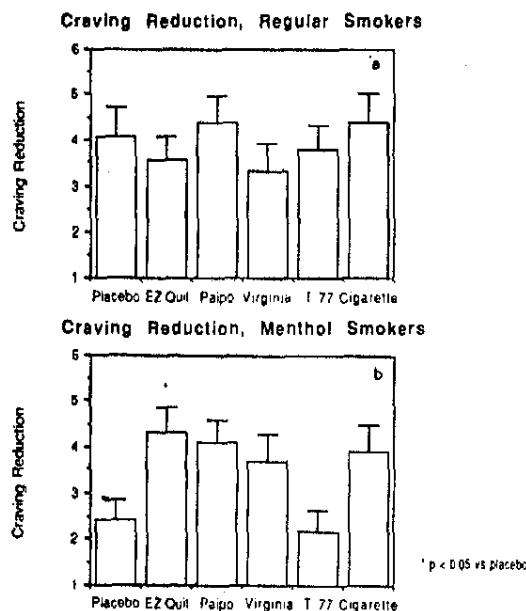


Fig. 4. The effect of flavor condition on "craving reduction" ratings by regular ( $N = 13$ ) and menthol ( $N = 12$ ) groups (mean  $\pm$  S.E.M.). (a) Craving reduction in the regular group. (b) Craving reduction in the menthol group.

source of the significant interaction, tests of the simple main effect of flavor condition within each group were conducted. With the regular group this test did not detect a significant overall effect of flavor condition. With the menthol group there was a significant effect of flavor condition ( $F(5, 55) = 4.59, P < 0.005$ ). Individual contrasts of means within the menthol group showed that the EZ-Quit flavor provided significantly greater craving reduction compared with placebo ( $P < 0.05$ ). Marginally significant enhancements of craving reduction were seen with the Paipo ( $P < 0.07$ ) and cigarette smoke ( $P < 0.06$ ) flavors compared with placebo. One principal difference between the two types of smokers is that the unflavored placebo cigarette caused a moderate decrease in craving in the regular group and only a small decrease in craving in the menthol group.

#### Puffing

There was a significant main effect of flavor on the question "Would you puff on this more than a cigarette?" ( $F(5, 115) = 5, 115 = 2.32, P < 0.05$ ). The main effect of group and the group  $\times$  flavor interaction were not significant. The only significant specific contrast was between the placebo and the T77 flavor. The smokers reported significantly less puffing on the T77 flavored device than the placebo ( $P < 0.05$ ).

#### Quitting

No significant effects of group or flavor were seen for the question "Would this device be useful in quitting?" The mean response for the placebo device was  $3.4 \pm 0.4$ . The mean responses for the different flavor conditions varied around the score for the placebo with the Vir-

ginia flavor receiving the low score of  $3.0 \pm 0.3$  and the cigarette smoke flavor receiving the high score of  $4.0 \pm 0.4$ .

#### Ranking

There was a significant main effect for ranking ( $F(5, 120) = 3.64, P < 0.005$ ). The mean ranks given each condition is shown in Table I. In general, for both regular and menthol smokers the Virginia and T77 flavors were ranked near or below the placebo, while the cigarette smoke, EZ-Quit and Paipo flavors were ranked above the placebo.

#### Discussion

These results provide initial evidence concerning the importance of flavor in cigarette substitutes. Interesting data were gathered not only concerning the effects of different flavors but also the differential ratings in some cases by smokers of mentholated and non-mentholated cigarettes.

For most of the measures the menthol and "regular" groups appeared to regard the different flavor conditions in the same way. The addition of the two flavors containing menthol (EZ-Quit and Paipo) to the cigarette substitute improved its ratings in terms of liking and satisfaction. The cigarette flavor provided improved rating of the substitute in terms of satisfaction only. The two commercial tobacco flavor additives ("T77" and "Virginia" flavors) were not found to enhance the rating of the cigarette substitute. These tobacco additives may have been ineffective because they were developed to complement the flavor of burning tobacco which was not present in the cigarette

Table I. Ranking of the different flavor conditions by regular ( $N = 18$ ) and menthol ( $N = 12$ ) groups (mean  $\pm$  S.E.M.).

Group	Flavor conditions					
	Placebo	EZ-Quit	Paipo	Virginia	T77	Cigarette
Regular	$3.2 \pm 0.4$	$4.2 \pm 0.5$	$4.4 \pm 0.5$	$2.7 \pm 0.4$	$3.1 \pm 0.5$	$3.4 \pm 0.4$
Menthol	$3.5 \pm 0.4$	$3.7 \pm 0.6$	$4.5 \pm 0.5$	$3.0 \pm 0.5$	$2.2 \pm 0.4$	$4.1 \pm 0.4$

sensation in the mouth and throat provided by the menthol may have provided an acceptable substitute for the tracheal stimulation that has been found to be critical for cigarette satisfaction (Cain, 1980; Rose, 1988; Rose et al., 1984; Rose et al., 1985).

Although no significant differences between flavors were obtained in response to the question "Would this device be helpful in quitting?", the subject sample studied here was not trying to quit smoking. Data from individuals attempting to quit smoking would be more helpful in answering this question. It is interesting that despite the lack of significant effect of flavor on the helpfulness question, there were significant effects on liking, satisfaction and craving reduction.

Clearly, more research is needed in this area. One crucial need is a better understanding of the importance of flavor in cigarette smoking and in substitutes designed to aid smoking cessation. Knowledge of the role of conditioned and perhaps unconditioned effects of sensory stimulation in smoking will facilitate the development of more effective smoking substitutes.

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#### References

- Ashton, H. and Stepney, R. (1982) *Smoking Psychology and Pharmacology*. Tavistock Publications, New York.
- Cain, W.S. (1980) Sensory attributes to cigarette smoking. In: Banbury Report 3: A Safe Cigarette? (Gori, G.B. and Bock, F.G. eds.), p. 239. Cold Spring Harbor Laboratory, New York.
- Keppel, G. (1973) *Design and Analysis: A Researcher's Handbook*. Prentice-Hall, Inc., Englewood Cliffs, NJ.
- Neter, J.W. and Kutner, M.H. (1985) *Applied Linear Statistical Models*. 2nd. ed. Richard E. Irwin, Inc., Homewood, IL.
- Reasor, B.A. et al. (1983) Sensory assessment of tobacco smoke. *Rec. Adv. Tobacco Sci.* 14, 3.
- Rose, J.E. (1988) The role of upper airway stimulation in smoking. In: *Nicotine Replacement: A Critical Evaluation*.

substitute. The two menthol flavors were the highest rated of the flavors in the current study. This may have been due to the presence of menthol in these flavors or to the fact that they were complex flavor mixtures developed as commercial smoking cessation aids. However, the significant increase in satisfaction provided by the cigarette flavor demonstrated that it was not necessary to add menthol flavor or to use a commercially developed smoking cessation aid to enhance the satisfaction provided by the cigarette substitute.

There were differential effects of the flavor conditions in smokers of mentholated vs. non-mentholated cigarettes with regard to craving reduction. With the regular group there was no significant effect of flavor condition on craving reduction. With the menthol group significantly enhanced craving reduction was seen with the EZ-Quit flavor and marginally significant trends toward reduced craving were seen with the Paipo flavor and the cigarette smoke flavor. One of the principal differences was that the regular smokers showed a moderate degree of craving reduction with the unflavored device while the menthol group did not. These results suggest that menthol smokers pay more attention to the presence of flavor for craving reduction than "regular" smokers, for whom handling and puffing on the unflavored device seemed to provide a moderate degree of relief.

In this study the subjects were permitted to use each device on an ad libitum basis. While this design did allow for unequal use of each device, all subjects tried puffing on all of the devices. The ad lib use of the cigarette substitutes provided a good approximation of how these devices would be used in a natural setting.

These results indicate that the addition of flavors, particularly menthol and mint flavors, can increase the acceptability of cigarette substitutes and increase their efficacy in relieving craving during smoking withdrawal. It is interesting that the menthol flavors were found to be favored even by smokers of non-mentholated cigarettes. Although not tested in the current study, it is possible that the cooling

- tion (Pomerleau, O.F. and Pomerleau, C.S., eds.), p. 95, Alan R. Liss, New York.
- Rose, J.E. and Hickman, C. (1987) Citric acid aerosol as a potential smoking cessation aid. *Chest* 92, 1005
- Rose, J.E. et al. (1984) Subjective response to cigarette smoking following airway anesthetization. *Addict. Behav.* 9, 211.

- Rose, J.E. et al. (1985) Sensory blockade of smoking satisfaction. *Pharmacol. Biochem. Behav.* 23, 289.
- Stepney, R. (1984) Human smoking behavior and the development of dependence on tobacco smoking. In: *Nicotine and the Tobacco Smoking Habit* (Balfour, D.J.K., ed.), p. 158, Pergamon Press, New York.

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