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VAPES: INFLUENCE OF FLAVOR ON LIKING AND DISLIKING OF VAPES

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ABSTRACT

Introduction: The current research focuses on how different flavors used in vapes influence the liking and disliking of vapes. The consumers are already aware about conventional tobacco cigarettes before e-cigarettes are introduced. The younger generation is very much attracted to cigarettes due to multiple reasons. Conventional cigarettes have tobacco whereas vapes have different flavors including tobacco also and attractive names also. Vapes are used to quit cigarettes. Sweet flavor is very attractive to consumers and to beginners.

Objective: To investigate how different vape flavours affect users preferences including their liking and disliking.

Material and Method: Participants: 62 adult vape users (sole and dual users).
Inclusion criteria: ≥20 years old, ≥2 months vaping, physically fit, medium nicotine use, etc.
Exclusion criteria: respiratory issues, olfactory problems, pregnancy, quitting programs, etc.

Study Design: Cross sectional descriptive study

Setting: Conducted in Lahore, Pakistan. Recruitment was through local colleges, offices and vape shops

Duration: 1st December 2024 to 30th June 2025

Data Collection: in millimeters from scales. ANOVA, Tukey tests, Pearson correlation, and regression analyses were conducted.

Results:

• Sweetness and coolness had a positive correlation with liking.
•Bitterness and harshness were negatively associated with pleasure.
•Sweetness alone explained 9.5% of variation in liking.
•Combined sensory properties explained up to 21.6% of variation.
•Panther Black and Drifter had the strongest sweet-pleasure associations.
•The majority preferred flavored e-liquids (especially sweet ones) over tobacco or menthol.

Conclusion: Sweet flavors significantly increase the liking of e-cigarettes. While this may help smokers switch from combustible cigarettes, it also poses a risk of attracting non-smokers and youth. Flavors, particularly sweet and cool ones, play a pivotal role in vape usage preferences. Further studies should investigate the chemical composition and concentration responsible for these preferences

Key words: Vape flavors, E-cigarettes, Liking and disliking, Sweetness, Psychophysical method, Sensory perception, Tobacco cessation, Vape behavior, Youth attraction, Flavor preference.

INTRODUCTION

The current research focuses on how different flavors used in vapes such as sweet, mint, sour and so many others have moulded the liking and disliking of vapes extended to e-cigarettes(1). Before the introduction of e-cigarettes conventional nicotine cigarettes were used, its smell and flavor are closely related to the pleasure and satisfaction of the consumer(2). As the young population is very attracted to cigarettes due to multiple reasons, their use is banned,

but not in the true sense as it is easily available in the market. The thing which prohibits it is the written warning mentioned on the side of the package that it is dangerous for health, a warning issued by the Ministry of Health(3).
In conventional cigarettes no flavors, herbs, or spice that is close to tobacco flavor is introduced in the cigarettes, however, it is not presumed that this forbidding would be presumed to be extended automatically to e-cigarettes under the ordinances that are in force from August 8th, 2016. Under these regulations the FDA has extended compliance level compared with flavored tobacco products with non-flavored tobacco products to examine the impact of flavor on tobacco. Emphasis was on e-cigarettes i.e. non-combusted flavored products. The objective was biphasic (a) nonsmokers will start smoking, particularly young generation (b) those who are already smoking will quit smoking.
One of the most attractive features of e-cigarettes is its flavor. To add more attraction the terms tobacco, menthol, nicotine is avoided and new terms such as names related to sweets, desserts etc. are used which are more familiar to youth(4). Research conducted previously has shown that sweet flavors can influence the increased use of e-cigarettes. Many adults use e-cigarettes to quit tobacco cigarettes. It was further reported that the majority of adult users preferred e-cigarette flavored products.
e-cigarettes have attracted a major group of youth due to their sweet flavor. A vast majority of students belonging to middle and high school use sweet flavor vapes and majority among them vape with sweet flavor. Our local community has a high potential for all new products which are already attracted by the western community, vapes, and e-cigarettes are one of them(5). Initially it is the flavor which attracts it and is easily accepted by the family who have no objection to its use. There is great potential among people using flavored e-cigarettes to smoke tobacco later in their lives. The common concern which attracts vapes to nonsmokers also draws attention to smokers using cigarettes currently, particularly among individuals who have some motivation in quitting smoking.
To study the subject in depth the flesh and blood between sweet flavors and liking/disliking of vapes a psychophysical method which is favored in studies of food products and consumableitems was used. In the current research an approach used previously by Rosbrook and Green was used to inquire the effect of flavor in relation to reaction to e-cigarette in adults.

MATERIAL AND METHODS

The participants were selected from Lahore, a total of 62 participants were selected who were sole and dual e-cigarette users. Selection was made by advertisements at different forums such as local colleges, offices and local vaping shops etc. This is a cross-sectional descriptive study. The study was conducted from 1st December 2024 to 30th June 2025 in Lahore.
The inclusion criteria for the participants are (1) Physically fit, (2) age ≥20 years (3) vaping period for ≥ 2 months (4) vaping with nicotine of medium strength and consented for blue e-cigarette of various flavors during the study period. For dual users the inclusion criteria are (1) smoking cigarettes currently (2) smoking cigarettesfor more than 02 years regularly, approximately 01 pack of 20 cigarettes per day. Dual users had to vape for 4-5 days a week to be included in the study. For sole users they must vape daily. Sole vape users could not use any other cigarette during the session. Exclusion criteria for dual as well as sole vape users if (1) any throat or mouth ulcers or any other problem which could cause problem in vaping during the study (2) olfactory problem that could cause taste problem as different flavors are going to be used (3) allergy to vaping (4) asthma or related respiratory problem (5) already engaged in quitting vaping program (6) pregnancy, lactating mothers. Instructions given to participants were asked to refrain eating, vaping and smoking (for dual users) 1 ½ hours prior to their planned visit. Informed consent was read and signed before the start of the study.

Session with material

Each participant was provided with an e-cigarette, blu-tank for vaping during the test session. Blu-tank is a new terminology which needs a bit of explanation at this stage. These are cigars like e-cigarettes with a closed system, which is non-refillable and is devoid of wicking material typical of cigalike products. Close to e-cigarettes, different styles, brands and flavors are available for attraction, that is why it is chosen as an example for this session. The flavors chosen were tobacco, menthol, paradise, Orifter, panther black and peach lemonade. These were chosen from the market, which are easily available with the same name, cheap and are in vogue with the commercial e-liquids. Medium nicotine is added to each flavor.

Test session

All sessions in which vaping was done by the participants and a separate chamber where no one was allowed to enter was provided. Proper ventilation was maintained, which is very important as it cleared the room for the next session as six sessions were run in succession.

Experimentation

Two parts were allocated for each session. For pleasure data collection and intensity scales. Both parts were conducted in the same place described previously on a one on one basis. Participants were explained in detail and trained to use pleasure and intensity scale, because they were used to gauge liking/disliking the intensity of flavor. Likert scale was used. The initial scale used is labeled pleasure scale (LPS) which is a bipolar category scale. The scale ranked as a

bipolar category ratio scale at the bottom is most disliked sensation and at the top is most liked sensation and the rest of sensations are within intermediate scales such as slight, moderate, very much and extremely in between according to their semantic magnitude, and neutral at midpoint. Measurement of the scale was done on a paper ballot, all the participants were trained how to display the intensity on the paper ballot before vaping.

Another scale used is a category ratio scale which is labeled a magnitude scale (gLMS) with no sensation given a boundary at the bottom and strongest imagination at the top, in between the two lies rest of the sensation's participants remember. The scale was displayed on a ballot paper by placing a dot or slash on the paper the sensation they remembered of the vape. The participants were given the liberty of 15 flavors they remembered. During the training session the data used was collected for internal validity for identification.

Once all the participants were trained properly, before the session they were asked to rinse their oral cavity with de-iodised water and spit out the water once proper rinsing is done. After that four puffs are taken from new flavor from e-cigarette, after vaping they are going to rate liking/disliking sample on LPS followed by rating the perceived intensities of five attributes i.e. sweetness, bitterness, harshness, coolness, own flavor on a separate scale. The own flavor is described by the participant himself and rate it accordingly. After this the oral cavity is again rinsed and some time is given approximately 8-10 minutes then next flavor is rated, in this way six different flavors are vaped and rated by the participants following all the steps.

Data Analysis

Data is analyzed in millimeters from the bottom range from -100 to +100 for LPS. For gLMS the same criteria were followed i.e. from the bottom of the scale in millimeters. The gLMS rating was log transferred before statistical analysis, and on LPS the epicurean response is generally distributed to all the participants.

To differentiate vapor flavors for the purpose of pleasure in grading and sensory ownership grading, (ANOVA) one-way analysis of variance along with Tukey's honest tests were performed to determine significance. In order to ascertain the linear relationship between liking /disliking and sensory ownership calculation was done by Pearson product moment correlations. To observe the comparative frequency effects of flavor ownership on pleasure grading, analyses were regressed to obtain results. If it was observed that similar participants produced grading various times for the similar flavor in the current study, this shows that their grading results were correlated. In order not to increase the level of significance, regression models of our study were approximated by non-independent observations adjusting for intraclass correlation. Stata V.14.1 were used for statistical analyses.

RESULTS

Participant features were tabulated in table-I. Out of 62 participants 70% were male and rest were females. The median age of all the participants, including both genders, was 42 years. 1/4thof the participants were dual users, averaging about 24 years of age. Dual users have been using e-cigarettes for the last 26 months, whereas sole users have been vaping for the last 1 1⁄2 years. Average nicotine strength used was 19.5 mg/ml for users who were dual and for sole users 15.1mg/ml. A variety of e-cigarettes were used by all the participants such as Paradise, Tokyo series, Irie vibes, Orifter, Solstice, Cosmic Fog, The Panther Black, Peach Lemonade, Tobacco, Mehthol. These flavors were collected from the local market where vape is common.

All the participants for a change used flavored e-liquids other than tobacco flavor, out of these the majority (80%) opted for flavored e-liquids when vaping. Few of the participants preferred traditional tobacco flavoring (n=12) or menthol (n=6). Among the common flavors the most preferred were Paradise (n=10), Orifter(n=8), The Panther Black(n=18), Peach Lemonade(n=8).

Table-I Participant Character

Gender (n=62)		**Age**	**Vape status**		**Duration of combustible cigarette smoking**	**Duration of vaping in months**		**Flavor of vape**					
Male	Female		Sole user	Dual user		Sole user	Dual user	Tobacco	Menthol	Paradise	Orifter	Panther Black	Peach Lemonade
36	26	40±5 years	38	24	15±3 years	38	24	24	12	12	6	6	2

From 62 participants 58% were males and 42% were females. The average age of vape users is 40±5 years including both genders. 61% of sole user's individuals were using e-cigarettes for 38 months, whereas 39% of dual users were using e-cigarettes for 24 months. The flavors used by the participants were tobacco (n=24), menthol (n=12), paradise(n=12), orifter(n=6), panther black(n=6) and peach lemonade(n=2).

Table-II correlation between ownership rating and specific dimension for vape flavors (n=62)

Sensory dimension	**Tobacco**	**Menthol**	**Paradise**	**Orifter**	**Panther Black**	**Peach lemonade**
Sweetness	0.31	0.33	-0.12	**0.35**	**0.55**	0.27
	P=0.074	P=0.057	P=0.502	**P=0.047**	**P=0.02**	P=0.133
Coolness	**0.43**	**0.51**	0.08	0.28	**0.12**	**0.42**
	P=0.012	**P=0.002**	P=0.630	P=0.116	P=0.545	**P=0.022**
Bitterness	-0.13	-0.30	-0.26	-0.35	-0.13	-0.06
	P=0.510	P=0.106	P=0.170	P=0.062	P=0.511	P=0.803
Harshness	-0.002	-0.02	**-0.41**	**-0.38**	**-0.38**	-0.18
	P=0.996	P=0.870	**P=0.027**	**P=0.0.31**	**P=0.041**	P=0.302
Own flavor	0.12	**0.61**	-0.12	0.32	0.31	**0.37**
	P=0.490	**P=0.000**	P=0.550	P=0.087	P=0.105	**P=0.033**

(Character shown in bold are statically significance values at $p<0.05$)

Table II highlights the universal relation between likelihood grading and expected intensities for every sensory dimension of the six vaping flavors. The sensation of pleasure was significantly related to sweetness for orifter (r=0.35, $p<0.05$) and panther black (r=0.55, $p<0.05$). A similar but weaker relationship was found between tobacco (r=0.31, p=0.07) and menthol (r=0.33, p=0.06). For the rest of the flavors no relationship was found to be significant. Sensation of pleasure was also found to be corelated with coolness for all six flavors. Statistically strong corelationship was found between tobacco, menthol and peach lemonade (r=0.43, 0.51 and 0.42). Comparatively harshness was negatively corelated with pleasure for paradise, orifter and panther black (r= -0.41, -0.38 and -0.38). Own flavor was positively corelated with menthol and peach lemonade (r=0.61, $P<0.000$ and r=0.37, $p<0.033$).
To observe the effect of sensory properties on likewise of vapes. Regression to sensory properties on pleasure rating was done. The data of all six flavors was aggregated in a single set (table-III). When an individual property was regarded as a factor, sweetness and coolness contribution was highlighted which was positive, contrary to that bitterness and harshness showed negative contribution to likewise of six vaping flavors. When sweetness was considered solely, 9.5% of the total fluctuation in pleasure rating was explicated, while coolness explicated 6.3% of fluctuation in pleasure rating to six flavors (Table-III)

Table-III: Regression coefficient with p values evaluating the effect of sensory dimension intensity rating on pleasure rating in variable sets

Sensory property	**Set-I**	**Set-II**	**Set-III**	**Set-IV**	**Set-V**	**Set-VI**	**Set-VII**

Sweetness	12.97 P=0.000	-	-	-	10.55 P=0.005	10.39 P=0.006	10.29 P=0.006
Coolness	-	6.01 P=0.006	-	-	4.50 P=0.040	4.69 P=0.031	4.68 P=0.026
Bitterness	-	-	-7.07 P=0.011	-	-7.05 P=0.002	-	-3.21 P=0.239
Harshness	-	-	-	-8.03 P=0.023	-	-8.22 P=0.012	-6.20 P=0.122
R^2	9.5%	6.3%	6.6%	7.9%	18.7%	21.1%	21.6%

After these three properties were added to the regression model to observe their effect on pleasure rating. More sensory properties were included, the total fluctuation in the pleasure rating was improved to 21.1%. After the inclusion of all four properties, a set i.e. Set VII was developed, even after it no further improvement was observed in pleasure rating (R=21.6%). All models of regression were figured after adjusting for interclass correlation affected by unbiased observations.

DISCUSSION

The findings from our research suggest that flavor plays an important role in liking and disliking vaping. A study conducted in 2022 by Hayes JE, Baker AN favors our research(6). At the forefront our research suggests that a negative association between bitter and harsh flavor was observed with the liking of vaping whereas sweet and cool flavors are positively associated with liking of vape, a study conducted in 2023 by Pauwels CG, Visser WF, Pennings JL, Baloe EP, Hartendorp AP, van Tiel L, et al and another study conducted by Baker AN, Bakke AJ, Branstetter SA, Hayes JE in 2021 is in favor of the current study(7, 8). The other side of the picture is that due to negative association of e-cigarettes with flavors of harshness and bitterness reduction in vaping have been observed with these flavors on the other hand sweetness and coolness improves liking of vaping in a laboratory study conducted by Bello MS in 2022 favors our study(9). In addition to the above, our findings suggest that sweetness has greater influence than coolness on vaping.

All our findings suggest that sweet flavor vape liquid plays an important role in attracting sole, dual and current cigarette users than any other flavor in an exploratory study in new Zealand conducted by McCormack JC, Muluh EAE, Mo Y, McLeod SC, Turner S, Ghelot DS, et al in 2024 favors our current study(10). As indicated previously by the close association between sweetness and liking/disliking ratio indicated in table-II, the rating of sweet flavor vapes are highly liked. By default, the liking of sweet substances is innate in human nature, sweetness can easily surpass bitterness.

The other finding narrated from this research is that adults were more attracted towards cooling properties of vape flavor, in addition young people are attracted to menthol flavor which suggests that in future this generation is going to be more divergent toward cigarette smoking in a study conducted in 2023 by Chaffee BW, Couch ET, Wilkinson ML, Donaldson CD, Cheng NF, Ameli N, et al and another study conducted by Davis DR, Morean ME, Bold KW, Camenga D, Kong G, Jackson A, et al in 2021 is in favor of this study(11, 12). The current study provides a true picture of psychophysical evidence for positive association between sweet flavor and its liking. The underlying mechanism of how sweet flavor increases or decreases liking or disliking for tobacco is unclear, this provides the base for use of flavor with tobacco products under existing rules in a systematic review conducted in 2022 by Notley C, Gentry S, Cox S, Dockrell M, Havill M, Attwood AS, et al favors our study(13). Since tobacco provokes numerous sensations and pleasure responses like food and other consumable products, the scales applied in tobacco regulatory research provide a better ground in understanding the role of flavor and its behavioral usage.

The findings of our study are not unexpected i.e. the strong association between liking and sweet flavor. A large group of adult e-cigarette users report using sweet flavor after starting to vape giving preference to tobacco flavor in a study conducted in USA by Harlow AF, Fetterman JL, Ross CS, Robertson RM, Bhatnagar A, Benjamin EJ, Stokes AC in 2022 favors our study(14). This study provides strong evidence in sweet flavor and liking in vapes.

CONCLUSION

Our finding suggests that sweet flavor increases the likelihood of e-cigarettes. The attraction of vapes in terms of flavor provides an opportunity to reduce smoking in current cigarette smokers, on the other hand they may indirectly harm, thus facilitating the start of tobacco products. If flavor is based as a major reason to initiate and continue vapes, further research is open to isolating the chemicals and their specific concentration which influence the liking and disliking of vapes. Finally, a balanced gradient needs to be determined for the attraction of flavored vapes and tobacco users to either quit or reduce their habit of smoking, particularly focusing youth.

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