JRIFST

https://journals.rifst.ac.ir
ISSN: 2252-0937(print), 2538-2357(online)

Journal of Research and Innovation in Food Science and Technology

Research Institute of Food Science and Technology

Volume 11, Issue 2, September 2022, Pages 199-208
Document Type: Extended Abstract
https://doi.org/10.22101/JRIFST.2022.330479.1330

Extended Abstract

The Effect of Charcoal Based Chewing Gums in Reducing the Concentration of Unwanted Substances and Compounds: Dyes, Microbes and Viruses in Saliva

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Recieved: 2022.03.08; **Accepted:** 2022.07.25

Abstract

Adding various substances to the chewing gums has led to the formation of new applications for them, which include drug delivery and oral and dental hygiene. In this research, the physicochemical and rheological properties of charcoal chewing gum were studied using chemical analysis and sensorial methods. The results of this study show that the addition of activated charcoal in the studied chewing gums has a Longer-lasting flavor and more saliva secretion. Longer-lasting flavor in charcoal chewing gum increases the acceptance and willingness to keep charcoal based chewing gums for panelists. In line with the results of sensory evaluation, histometric analysis of charcoal and non-charcoal based chewing gums shows the same texture profile against pressure on both types of chewing gum, with the difference that the maximum pressure tolerance threshold in charcoal based chewing gums is higher than in chewing gums without charcoal. In general, it seems that increasing the susceptibility along with increasing saliva secretion and increasing the pH in general create a suitable substrate for more activated charcoal in chewing gum and therefore the efficiency of charcoal chewing gum to absorb unwanted substances such as dyes, microbes and viruses in saliva. Therefore, it is expected that the use of charcoal gum by reducing the concentration of microbes and viruses in saliva can have a great impact on oral health, dental protection, general health, and reduce the prevalence of infectious and viral diseases.

Keywords: Charcoal, Charcoal based chewing gum, Virus

Introduction

Nowadays, chewing gum is not just a chewable sweet. Adding various substances to the chewing gums has made them have useful applications in order to improve the quality of oral hygiene and teeth health (Daniell *et al.*, 2022). In this regard, researchers and manufacturers tried to create various applications for their gums by using different substances such as caffeine, nicotine, tryptophan, etc. Regarding the effect of chewing gum on reducing the concentration of viruses in saliva, we can refer to a study in which chewing gum was used to reduce the concentration of Sars-Covid-2 virus in saliva (Singh *et al.*, 2021). Various observations showed that the saliva of sick people often contains a high concentration of the virus (Cookson & North, 1967). Fig. (1) shows the life cycle of the virus and how it binds to cell surface proteins. The researchers produced a chewing gum that contained high levels of the plant proteins (Su *et al.*, 2021). To check the effectiveness of these gums, researchers prepared a preliminary sample of saliva from sick people and mixed it with a mixture of powdered gum samples. The results of the experiments showed that saliva mixed with chewing gum can greatly reduce the concentration of viruses in the mouth. The first study in the field of virus removal with the help of activated charcoal in order to treat some viral diseases in the oral region was done by Cookson & North (1967). Matsui *et al.* (2015) showed that when virus-infected saliva is exposed to activated charcoal, it can have a significant effect on the concentration of viruses in saliva. In this research, based on sensory and chemical evaluation tests, the effect of activated charcoal on the rheological, histological, chemical and physical properties of charcoal based chewing gum was done.

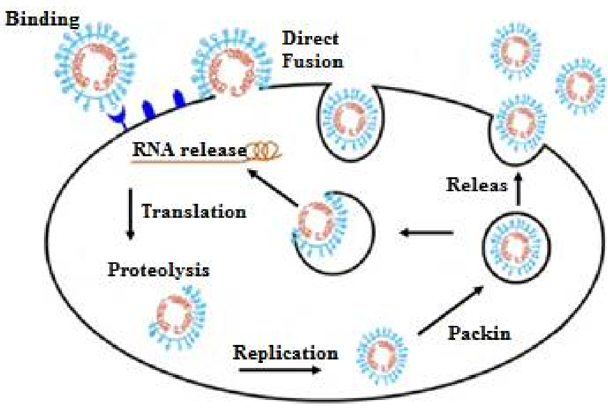

Fig. 1. Life cycle of SARS-CoV-2 and the binding to the cell surface (Su *et al.*, 2021)

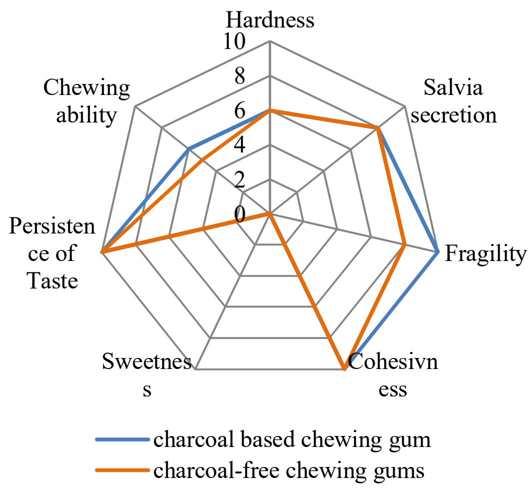

Fig. 2. Sensory evaluation of charcoal and non-charcoal chewing gums

Materials and methods

In order to investigate the effect of activated charcoal on the chemical and rheological properties of chewing gums, first, laboratory samples of charcoal and non-charcoal based chewing gums were prepared and they differed from each other only in the presence of activated charcoal (about 0.5%). In order to investigate the characteristics of charcoal-based chewing gums as well as the effect of chewing them on pH and saliva volume, a sensory evaluation was performed by 30 evaluators (15 girls and 15 boys) in the age range of 15 to 30 years. In each of the studied cases, they were asked to rate the samples based on general hedonic qualities, from very unpleasant to very pleasant. Then these adjectives were converted into numbers from 1 to 10 (Muþnoz & King, 2007). The texture of each chewing gum was measured using a texture measuring device (TA.XT Express, made in England). In order to perform this test, a cylindrical probe was used at a speed of 2 mm/s at a temperature of 26 °C. In order to measure the pH and volume of saliva, the basic saliva volume and pH were measured first. The difference in the weight of these absorbents before and after the chewing operation showed the amount of saliva secretion. Therefore, the participants were asked to continue chewing gum with charcoal and without charcoal for 30 minutes, and then the volume and pH of saliva were measured. pH measurements of saliva samples collected from volunteers were obtained immediately after sampling. After 48 hours, the test was repeated on the studied gums and at the end the obtained information was statistically analyzed.

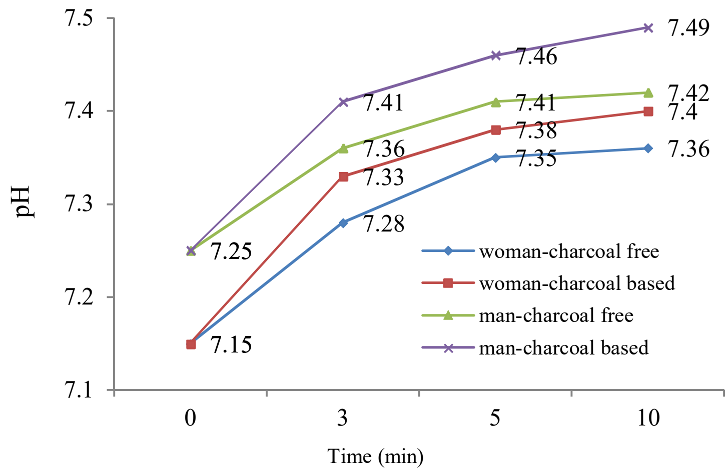

Fig. 3. pH variations in saliva after 3, 5 and 10 min

Table 1. Saliva secretion during chewing gum

saliva secretion (mL)	volunteer	3 min	5 min	10 min
Normal	woman	1.14	1.11	1.14
	man	0.93	0.96	0.93
Charcoal Free Chewing Gum	woman	1.24	1.2	1.22
	man	0.99	1.05	1.02
Charcol Based Chewing Gum	woman	1.38	1.37	1.43
	man	1.15	1.19	1.16

Results and discussions

As mentioned, the sensory evaluation was done by evaluators including hardness, chewability, taste, persistence of taste, intensity of sweetness, fragility, appearance attractiveness, cohesiveness of texture, stickiness and sensation of saliva secretion in the mouth. No difference was observed between these two types of chewing gum. As can be seen in Fig. (2), the main difference between charcoal based and non-charcoal chewing gums is in the durability of the taste and the amount of saliva secretion. The increase in saliva secretion and the acidic properties of saliva will have a significant effect on tooth decay and oral hygiene, as well as the concentration of microbes and viruses in the mouth (Chandel *et al.*, 2017). In a healthy person, the range of unstimulated saliva secretion is 0.1 to 0.5 ml/min and stimulating saliva is 1.1 to 3.0 mL/min, the results of these tests are shown in Table (1). As can be seen in Fig. (3), the presence of charcoal increases saliva secretion regardless of gender and age, and as expected, this difference is greater in long periods of times gum chewing. The results of the present research are in accordance with the results of the research conducted regarding the structures of activated charcoal receptors for reducing microbial and viral contamination in the mouth and saliva (Dong *et al.*, 2020). As can be seen from Fig. (4), the maximum pressure applied in charcoal gum is slightly larger than that of normal gum may be due to the fact that activated charcoal has acted as glue between gum base and sweetener

(Variava *et al.*, 2013). In this research, to measure the absorption ability of different substances by activated charcoal, coffee solutions with different concentrations were used and the absorption reduction percentage of each sample was measured before and after the chewing operation at a wavelength of 276 nm. The results show the maximum absorption for each of the control solutions and the samples after the chewing operation. As seen from Fig. (5), the decrease in the amount of absorption of each of the coffee solutions indicates the removal of impurity materials such as colors due to the activated charcoal present in the chewing gum (Matsui *et al.*, 2015).

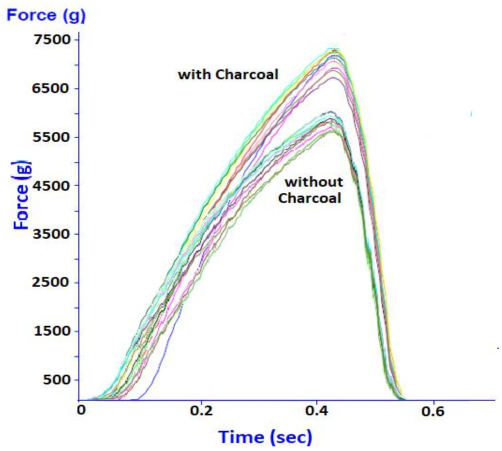

Fig. 4. Texture profile of charcoal and non-charcoal chewing gum

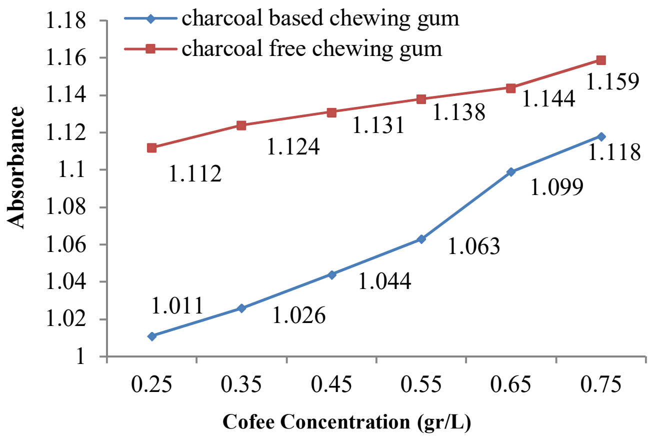

Fig. 5. Maximum absorption of chewed chewing gum

Conclusions

Based on the results, the use of charcoal increased saliva secretion by about 10 to 15 percent. After 3 min, the pH trend was stable for those who used non-charcoal chewing gum. But the pH changes in the saliva of people who used charcoal based chewing gum continued. The comparison of the maximum absorption of the solutions containing charcoal and without charcoal indicates that the removal of impurity is more in dilute solutions. The texture analysis of the targeted gums showed the same texture profile against the application of pressure on the gums, while the threshold of maximum pressure tolerance was higher for the charcoal based chewing gum than for the gum without charcoal. It can be concluded from all the experiments that adding activated charcoal in the texture of gums has increased the acceptability and willingness to keep the gum. The difference in the appearance of the color of the gums did not create any preference for selection. In general, it can be said that the longer lasting taste along with the greater desire to keep gum in the mouth and the increase in pH, which was associated with more stimulation of the salivary glands and increased saliva volume, created a suitable platform for the higher efficiency of activated charcoal in saliva. According to the above, it can be expected that the long-term use of charcoal gums will have a very positive effect on the absorption of unwanted substances and compounds such as dyes, microbes and viruses in saliva and the oral cavity. Increasing the volume of saliva and reducing the concentration of these substances in saliva can greatly reduce the risks caused by the adverse effects of these substances in the mouth and teeth.

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