

Author: Emel Hasan Yusuf

PhD Title: Novel Carrot Snacks with Desired Health Benefits

Discipline: Nutrition and food technology

Field of science: Agricultural sciences

Abstract date: 05/06/2023

Keywords: colorful carrot varieties, carrot juices, dried carrot snacks, carrot-blended smoothies, polyphenolic compounds, carotenoids, anti-aging, anti-obesity, anti-diabetes.

ABSTRACT

Global dietary guidelines support boosting fruit and vegetable consumption and recommend five portions of fruit and vegetables per day. It results from the fact that fruit and vegetable consumption prevents cardiovascular disorders, obesity, diabetes, and cancer. Orange carrot is one of the top 10 consumable vegetables worldwide, famous for its high carotenoid and nutritional contents. However, different colored carrot varieties show other bioactive compounds and biological activities, as well. Yellow carrots are abundant with xanthophylls, purple carrots are rich in anthocyanins and white carrots contain colorless polyphenolic compounds. Therefore, the orange carrot is the most used carrot variety for food production, but for novel foods, other colored carrot varieties may apply for the production with different nutritional contents and sensorial characteristics, and may also bring a different perspective to the consumers.

Therefore, the study aimed to investigate 12 carrot varieties with different sizes and colors as appealing raw materials for the development of innovative snack products. These snacks were intended to possess enhanced health benefits and sensorial characteristics. For this purpose:

- (i) the chemical composition, and health-promoting properties of different variants of carrots were analyzed;
- (ii) carrot juices were produced and analysed for physicochemical features, nutritional contents, biological activities and sensorial characteristics;
- (iii) carrot-based smoothies were prepared and evaluated for physicochemical features, nutritional contents, biological activities and sensorial characteristics;
- (iv) purple, yellow, orange and white carrots were used with fruit solutions by osmotic dehydration, convective drying and microwave vacuum drying technologies to prepare dried carrot snacks. Dried carrot snacks were evaluated for physicochemical features, nutritional contents, biological activities and sensorial characteristics as well.

According to the results of raw carrot materials with different colors and sizes, the purple carrot samples had the highest values for the content of polyphenolics and carotenoids, with the highest activities against cholinesterase. Normal purple carrots showed the highest health-promoting activities in all tests and followed by mini purple carrots. In turn, the yellow carrot showed the lowest values for the content of polyphenols and antioxidant activities, while the white carrot demonstrated the lowest results for total carotenoid and chlorophyll contents. Thus, and create features of functional products. Therefore, the conducted study had shown that different-sized (normal, mini and micro) purple carrot varieties can provide high contents of polyphenolic compounds to combat oxidative stress-related diseases, and may

increase the effectivity of the sensorial characteristics of carrot-based novel, functional foods.

Following the results of carrot juices, normal purple carrot juice demonstrated the best results for total phenolic acid, anthocyanin, and carotenoid contents, which had a direct impact on its pro-health potential. This juice was characterized by the highest biological and antioxidant potential, except for the α -glucosidase, and acetylcholinesterase inhibition. Normal yellow carrot juice showed the highest acetylcholinesterase inhibition activity with the lowest α -amylase and lipase enzyme inhibitions. For the results of carrot juice sensory evaluations, the best variety was the normal orange carrot, while the worst juice was voted as the base of white carrots. Hence, purple carrot juices can be used by beverage industries for the production of smoothies and/or blended juices for increasing the health-promoting characteristics of liquid products, but for creating the most preferable taste, the orange carrot variety is the most popular.

The results of carrot-based smoothies showed that the sour cherry juice–purple carrot smoothie had the highest total phenolic acid, anthocyanin and polymeric procyanidin contents. The raspberry juice–purple carrot smoothie showed the highest activities against lipase and butyrylcholinesterase enzyme inhibitions. Moreover, these characteristics are not only important for the nutritional perspective but also provide opportunities for beverage processing. Although, the apple juice–white carrot smoothie was voted for the highest product acceptance, the smoothie did not show potent nutritional content and biological activities.

Finally, combined methods of osmotic dehydration in fruit juices, convective drying and microwave vacuum drying made it possible to obtain stunning novel-colored dried carrot snacks. The osmotic dehydration process increased the polyphenolic contents in the dried carrot samples. Moreover, the highest phenolic acid, anthocyanin, flavan-3-ol, polymeric procyanidin and flavonol contents were determined in samples dehydrated with sour cherry and chokeberry solutions. In turn, the lowest total phenolic content was observed in the orange carrot osmotically dehydrated in apple solution. Sensorial evaluations of each carrot snack indicated significant differences, the highest color acceptance was in the purple carrot-apple juice samples, the highest flavor score was observed in the orange carrot-sour cherry samples, while the highest overall taste score was voted for the white carrot-apple solution samples. Thus, the applied process provided novel and sensorily acceptable functional dried carrot snacks.

To conclude, normal-sized carrot varieties (purple, yellow and white) are suggested for novel food applications. Moreover, combinations of carrot materials with fruit solutions enrich bioactive compounds, as well as sensorial characteristics and boost the health-promoting features of final carrot-based food products.