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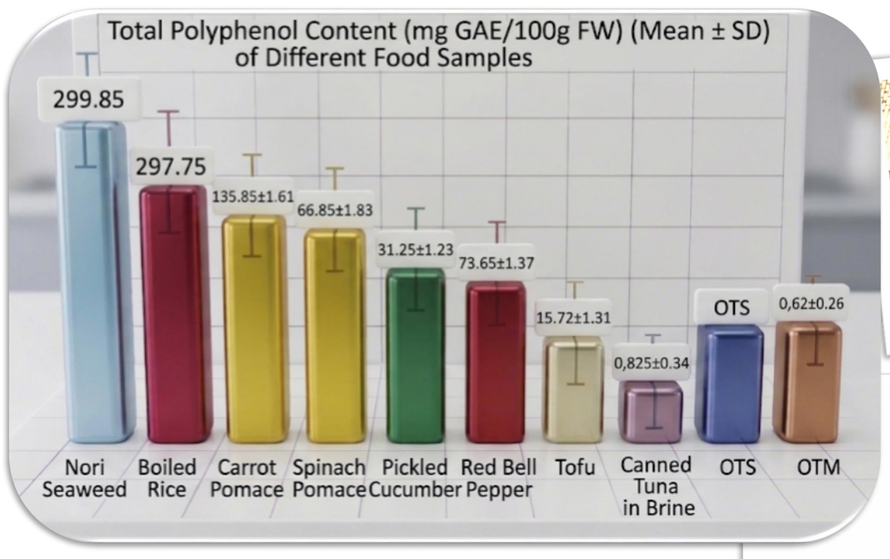
VALORISATION OF CARROT AND SPINACH POMACE IN RICE BALLS (ONIGIRI) WITH TUNA OR TOFU: ANTIOXIDANT PROPERTIES, PROXIMATE COMPOSITION AND SENSORY ACCEPTABILITY

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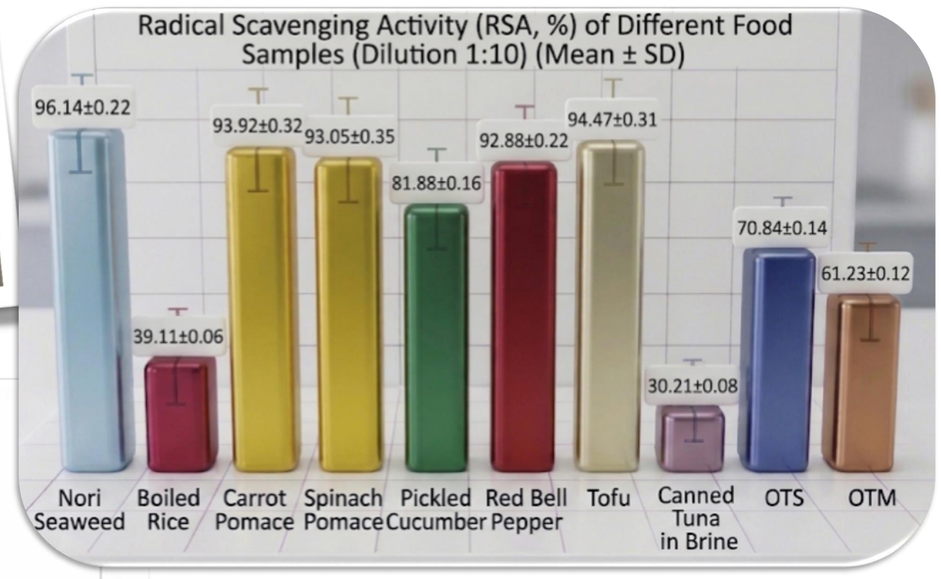
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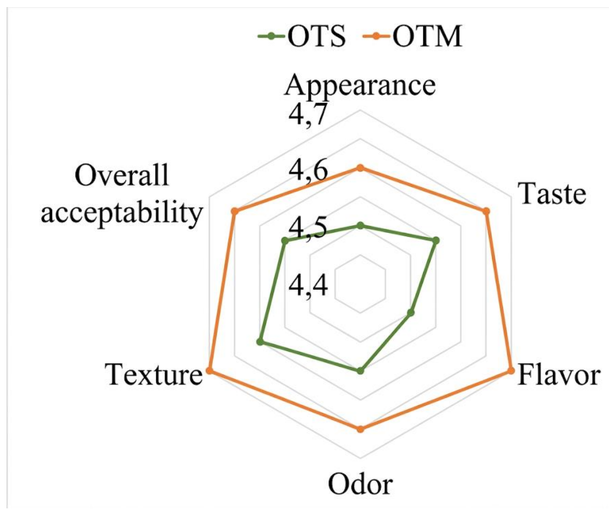
Abstract: The food industry generates large quantities of by-products that are rich in dietary fibre and phenolic compounds. This study aimed to develop two innovative onigiri (Japanese rice ball) assortments enriched with vegetable pomace obtained from juice extraction. The first (OTS) contained spinach pomace and tofu. The second (OTM) contained carrot pomace and tuna in its own juice. Both were based on cooked sushi rice (69%) and also contained red bell pepper, pickled cucumber and Nori seaweed flakes. The technological flow and the material balance were established. Total polyphenol content was determined by the Folin–Ciocâlteu method and antioxidant activity by the DPPH radical scavenging assay. Proximate composition and energy value were calculated using a nutritional database. Sensory acceptability was assessed by 20 panellists on a five-point hedonic scale. Among the raw materials, Nori flakes (299.85 mg GAE/100 g FW) and tofu (238.03 mg GAE/100 g FW) had the highest polyphenol content, followed by carrot pomace (220.83 mg GAE/100 g FW) and spinach pomace (218.63 mg GAE/100 g FW). The pomaces also showed DPPH radical scavenging activity above 93%. OTS had a higher total polyphenol content (75.67 vs. 45.29 mg GAE/100 g FW) and higher radical scavenging activity (70.84 vs. 61.23%) than OTM. A strong positive correlation between phenolic content and antioxidant activity was observed. OTS contained more lipids (1.5 vs. 0.62%), dietary fibre (1.22 vs. 1.14%) and minerals (0.8 vs. 0.6%). OTM contained more protein (5.9 vs. 4.5%). Both products were low in fat and had moisture contents of about 71%. Both were rated as highly acceptable. OTM obtained the higher overall acceptability score (4.65 vs. 4.55), which was attributed to its umami taste and juicier texture. The results show that carrot and spinach pomace can be technologically integrated into rice-based convenience products with added nutritional and functional value. This supports circular economy principles and offers a route to by-product valorisation in the food industry.

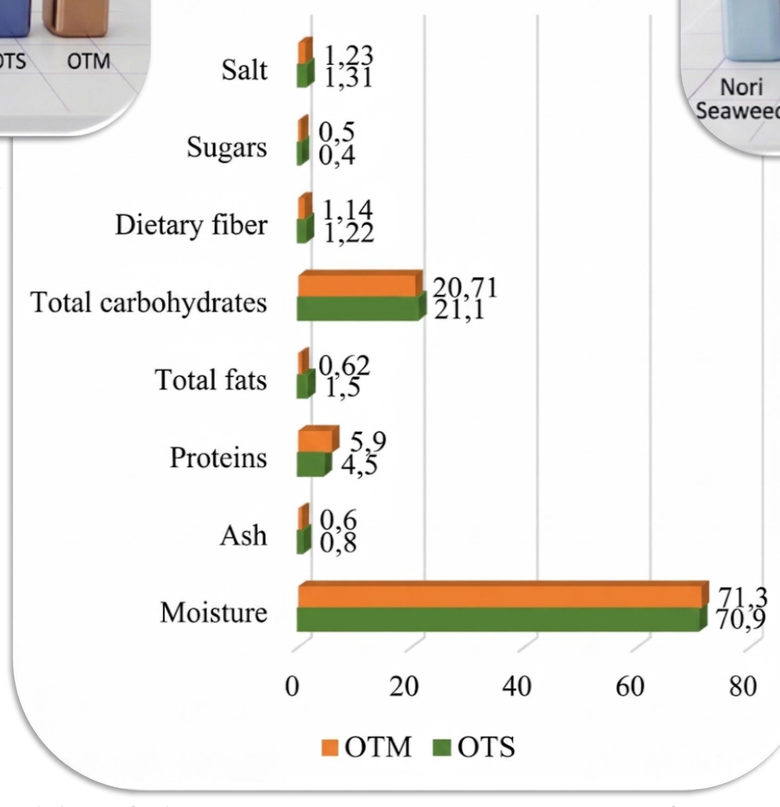
• Results and discussions

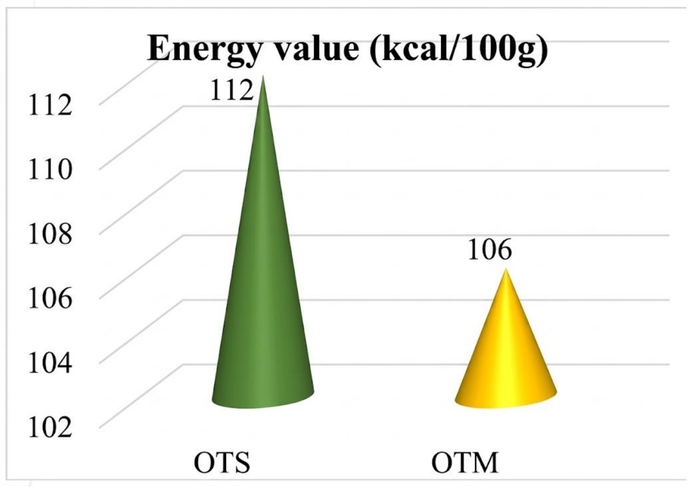












• Conclusions

The work successfully demonstrated the technological feasibility of obtaining two innovative assortments of onigiri (OTS and OTM) by capitalizing on juice industry by-products (spinach and carrot pomace). This approach supports current circular bioeconomy trends, transforming agri-food waste into value-added functional ingredients. In full agreement with the polyphenol analysis, the radical scavenging activity (RSA) determined at a 1:10 dilution highlighted a more pronounced efficiency in OTS compared to OTM, with a difference of 15.70% in favor of the product enriched with spinach by-products. The study confirms a strong positive correlation between the polyphenol concentration and the antioxidant potential of the products. Both assortments fall into the category of 'highly acceptable' products (scores > 4.5 on the hedonic scale). However, to increase the commercial attractiveness of the OTS assortment and bring it to the level of OTM, fine-tuning the recipe through techniques to mask astringent vegetable flavors or by finely adjusting the salt/sugars ratio is recommended