

Some current highlights of banana, avocado and mango wastes utilization: a brief overview

Vanya Zhivkova*

University of Economics – Varna, blvd “Knyaz Boris I” 77, 9002 Varna, Bulgaria

Abstract. Adding value and extracting benefits from fruit wastes is consistent with sustainable perspectives and circular concepts. This paper aimed to present some current highlights related to the latest research valorization aspects regarding the search for avenues and opportunities for utilization of banana, avocado and mango wastes. To fulfill the set goal, a specific search was conducted for relevant keywords in scientific databases; a descriptive approach was used. The objective of the present paper formulated in this way allows to track the progress at some intervals in terms of renewing and updating the latest scientific achievements related to the successful efficient valorization of banana, avocado and mango wastes.

1 Introduction

The current treatment of fruit wastes, including banana, avocado and mango wastes, calls for an increasing discussion of the possibility of considering these waste materials as potential resources to which sustainable approaches could be applied with a view to their effective valorization. Circular perspectives for future sustainability, for example, in conjunction with the development and eventual implementation of biorefinery strategies to add value to banana, avocado and mango wastes are part of contemporary environmental concepts of seeing fruit waste as a possible source of benefit generation [1 – 9].

The purpose of this paper is to briefly present some current highlights of the latest valorization aspects related to conducting research on the utilization of banana, avocado and mango wastes.

2 Materials and methods

A search was carried out on keywords “banana waste”, “avocado waste” and “mango waste” among the most recent scientific publications in the specialized literature; the descriptive approach was used to prepare the present paper. Out of the scope of this work remained the articles in press, book chapters, as well as the detailed bibliographic description of all available information in the various scientific databases. The goal set in this way allows the research on the specified keywords to be periodically updated, expanded and enriched.

* Corresponding author: v_jivkova@abv.bg

3 Results and discussion

The author thinks it is appropriate to present the publications cited in the paper in a summarized form according to some basic terms related to the subject under consideration, concerning the utilization of wastes from three specific fruits, and contained in the titles of the articles or presented as keywords, alone or as part of a word combination (Table 1).

Table 1. Summarization of the publications used in this paper by the presence of some basic terms.

Basic terms	Reference
<i>presented in the article's title:</i>	
“waste/wastes”	[4], [7], [8], [10 – 17]
“peel/peels”	[3], [8], [9], [13 – 15], [18 – 27]
“seed/seeds”	[16], [27 – 30]
“skin”	[30]
“stone”	[31]
“kernel”	[17]
“by-product/by-products”	[1], [2], [5], [6], [25]
“biorefinery/biorefineries”	[4], [6], [11]
“sustainable”	[4], [12], [15], [18]
“utilization”	[6]
“valorization”	[8], [10], [17]
“valorizing”	[19]
<i>contained among the keywords:</i>	
“waste/wastes”	[11], [12], [15], [18 – 20], [30], [31]
“peel/peels”	[7 – 9], [13], [14], [21], [23], [25 – 27]
“seed/seeds”	[5], [7], [27]
“kernel”	[7]
“by-product/by-products”	[2], [5]
“biorefinery”	[6], [11]
“sustainable”	[4], [15], [30]
“sustainability”	[12], [20]
“utilization”	[2], [5], [15], [20]
“valorization”	[1], [8]

As is clear from the data presented in Table 1, the following terms occur simultaneously in the titles of cited sources and are also present as keywords: “by-product/by-products” [2], [5]; “sustainable” [4], [15]; “biorefinery/biorefineries” [6], [11]; “valorization” [8]; “peel/peels” [8], [9], [13], [14], [21], [23], [25 – 27]; “waste/wastes” [11], [12], [15]; “seed/seeds” [27].

Some of the most recent research highlights related to the possibilities of utilization of banana, avocado and mango wastes are systematized in Table 2.

Table 2. Some highlights of banana, avocado and mango waste utilization.

Some current highlights	Reference
<i>Banana waste utilization highlights</i>	
steam gasification	[10]
biochar	[13]
activated carbon	[18]
rutin extraction	[19]
adsorbents	[21]
Ca-biocomposites	[22]
biodegradable film	[23]
poultry feed	[27]
<i>Avocado waste utilization highlights</i>	
biorefinery	[11]
Cu ₂ O nanoparticles synthesis	[15]
cellulose-rich filler for gelatin-based films	[16]
carbon quantum dots	[24]
poultry feed	[27]
bioadsorbents	[30]
<i>Mango waste utilization highlights</i>	
vegan leather bags – consumer consumption	[12]
antibacterial film	[14]
different mango kernel comparison	[17]
antioxidant and antimicrobial activities	[20]
antioxidant, enzymatic, and antimicrobial activity	[25]
antioxidant activity, total phenolic content, and total flavonoid content	[26]
throated downdraft gasification	[28]
3D anode	[29]
biosorbent	[31]

From the table 2, it can be seen that the research directions in which scientists are working intensively in search of possible ways to utilize banana, avocado and mango wastes are diverse. Research trends are also related to outlining perspectives and challenges accompanying the processes of effective ecological valorization of these fruit wastes.

4 Conclusion

The scientific publications used here give reason to conclude that the proper and successful management of banana, avocado and mango wastes is related to the application of integrated approaches based on circular principles and long-term sustainable goals. Achieving ecological valorization efficiency could be accomplished both by reducing the total amount of fruit waste generated and by developing and implementing various complex strategies to add value to these materials and turn them into a useful resource from which they can be realized great benefits in various aspects.

References

1. N. Choudhury, C. Nickhil, S. C. Deka, *Food Bioscience* **56**, 103416 (2023)
2. P. Kumari, S. S. Gaur, R. K. Tiwari, *eFood* **4(5)**, e110 (2023)
3. M. Bhavani, S. Morya, D. Saxena, C. G. Awuchi, *International Journal of Food Properties* **26(1)**, 1277-1289 (2023)
4. T. Sandoval-Contreras, F. González Chávez, A. Poonia, M. Iñiguez-Moreno, L. Aguirre-Güitrón, *Recycling* **8(5)**, 81 (2023)
5. T. Tesfaye, M. Ayele, M. Gibril, E. Ferede, D.Y. Limeneh, F. Kong, *Current Research in Green and Sustainable Chemistry* **5**, 100253 (2022)
6. B. Rodríguez-Martínez, A. Romani, G. Eibes, G. Garrote, B. Gullón, P. G. del Río, *Bioresource Technology* **364**, 128034 (2022)
7. M. García-Mahecha, H. Soto-Valdez, E. Carvajal-Millan, T. J. Madera-Santana, M. G. Lomeli-Ramírez, C. Colín-Chávez, *Molecules* **28(1)**, 458 (2023)
8. G. C. Jeevitha, S. Ramamoorthy, F. Ahmad, R. Saravanan, S. Haque, E. Capanoglu, *International Journal of Food Properties* **26(2)**, 3492-3511 (2023)
9. A. Tariq, A. Sahar, M. Usman, A. Sameen, M. Azhar, R. Tahir, R. Younas, M. I. Khan, *Food Bioscience* **53**, 102669 (2023)
10. R. Saini, S. M. Mahajani, S. D. Barma, D. S. Rao, *Journal of Cleaner Production* **434**, 139955 (2024)
11. D. Sousa, D. Rodrigues, P. M. Castro, H. A. Matos, *Processes* **12(1)**, 91 (2024)
12. N. Maitree, P. Naruetharadhol, S. Wongsachia, *Cleaner Materials* **11**, 100232 (2024)
13. J. Sreńscek-Nazzal, A. Kamińska, J. Serafin, B. Michalkiewicz, *Materials* **17(4)**, 872 (2024)
14. Z. Chen, R. Liu, Y. Wei, B. Li, W. Luo, X. Zhu, C. Huang, *LWT – Food Science and Technology* **197**, 115933 (2024)
15. F. Özbaş, *Journal of the Turkish Chemical Society Section A: Chemistry* **11(1)**, 303-312 (2024)
16. S. T. W. Amelia, S. N. Adiningsih, W. Widiyastuti, T. Nurtono, H. Setyawan, C. Panatarani, D. Praseptianga, N. Nazir, F. A. Syamani, *Bioresource Technology Reports* **25**, 101725 (2024)

17. R. M. El-Shabasy, T. F. Eissa, Y. Emam, A. Zayed, N. Fayek, M. A. Farag, *Scientific Reports* **14**, 2886 (2024)
18. O. J. Al-sareji, R. A. Grmasha, M. Meiczinger, R. A. Al-Juboori, V. Somogyi, K. S. Hashim, *Materials* **17(5)**, 1032 (2024)
19. A. M. Ferreira, G. S. V. Boas Barros, J. P. Wojeicchowski, J. A. P. Coutinho, *Food Chemistry Advances* **4**, 100612 (2024)
20. P. Koirala, P. Chunhavacharatorn, U. Suttisansanee, S. Benjakul, K. Katewongsa, F. Al-Asmari, N. Nirmal, *Frontiers in Sustainable Food Systems* **8**, 1354393 (2024)
21. Z. Huang, R. Campbell, C. Mangwandi, *Molecules* **29(5)**, 990 (2024)
22. V. Ospina-Montoya, S. Pérez, J. Muñoz-Saldaña, A. Forgiionny, E. Flórez, N. Acelas, *Journal of Environmental Management* **352**, 120029 (2024)
23. P. Verma, R. Rani, D. Das, K.K. Rai, P. Gogoi, L.S. Badwaik, *Sustainable Chemistry and Pharmacy* **37**, 101356 (2024)
24. H. Ferjani, S. Abdalla, O. A. Oyewo, D. C. Onwudiwe, *Inorganic Chemistry Communications* **160**, 111866 (2024)
25. N. Kučuk, M. Primožič, P. Kotnik, Ž. Knez, M. Leitgeb, *Foods* **13(4)**, 553 (2024)
26. D. Wigati, D. K. Pratoko, *Jurnal Sains dan Kesehatan* **6(1)**, 142-148 (2024)
27. A. Djulardi, H. D. Triani, A. Yuniza, *International Journal of Veterinary Science* **13(1)**, 42-50 (2024)
28. B. I. Ali, D. G. Gunjo, *International Journal of Thermofluids* **22**, 100608 (2024)
29. N. A. M. Barakat, S. Gamal, Z. K. Ghouri, O. A. Fadali, O. H. Abdelraheem, M. Hashem, H. M. Moustafa, *RSC Advances* **14(5)**, 3163-3177 (2024)
30. S. Orozco, E. Montiel, J. E. Valencia, R. Guerra González, M. del Carmen Chávez Parga, J. A. Cortés, M. Rivero, *Water, Air, & Soil Pollution* **235**, 155 (2024)
31. A. C. Ribeiro, E. F. D. Januário, T. B. Vidovix, A. M. S. Vieira, E.d.C.N.F.d.A. Duarte, R. Bergamasco, *Chemosphere* **346**, 140520 (2024)