ENSURING SUSTAINABILITY THROUGH THE RECOVERY OF WASTE RESULTING FROM THE OBTAINING OF FRUIT JUICE

Denisa MARICA (SOPIRLA)
Doctoral School of " Lucian Blaga" University of Sibiu, Romania
E-mail: denisa_marica85@yahoo.com
Ovidiu TITA
" Lucian Blaga" University of Sibiu, Romania
Maria Lidia IANCU
" Lucian Blaga" University of Sibiu, Romania

Abstract: *Most people buy more food than they need either because it's on sale or cheaper in larger quantities. Recovering and otherwise reusing surplus food that would otherwise be wasted helps with food security, biodiversity, the bioeconomy, waste management and renewable energy. After processing the fruits to obtain the juice, we have waste that can be used in order to obtain a good profit. Food waste occurs due to crops left in the field during productive years due to the higher price for harvesting and processing compared to the selling price, this due to the lack of appropriate machinery. Losses during transportation, storage, processing, food wasted due to buying too large quantities, a faulty use of stocks, too much unsold food approaching the expiration date (a production controlled according to market demand). We will look for methods how to reduce losses and how to make the most of the waste produced during fruit juice extraction. We will discuss safe packaging without additional waste generation, re-use of processing waste (borhot – jams/sweets/pet food/alcoholic drinks, rotten fruit – compost) and efficient supply of food along the chain food and to the consumer.*

Keywords: *apple juice, waste, reuse, sustainability.*
JEL Classification*: L66, I15.*

1. Introduction

Fruits and the products obtained from them represent a valuable part of the human diet, providing nutrition and dietary diversity. Apples are rich in organic acids, sugars, mineral elements and other nutrients, which play an important role in human health. Fruits can be processed in canneries to obtain jams, compotes, juices, nectars, alone or mixed with other fruits. When obtaining these products, healthy, mature fruits are used that can offer a good taste, a characteristic appearance and provide the specific need for nutrients. In a crop we not only have such fruits but also fruits that have not reached maturity or have visible defects. For example: in order to capitalize on all apple production, it is necessary to find a destination for all apples. Immature apples can be exploited by using them as natural acidifiers in the food industry (Cruceanu, 2021). Rotten apples make excellent fertilizer for flowers and vegetables, so they can be composted. But the rules for collecting and obtaining organic raw material must be respected, that is, fruits that have been treated with pesticides or other chemical substances, for 90 days after processing, are not recommended to be used to obtain fertilizer. Fruits affected by moniliosis or other fungal diseases cannot be used to obtain compost. Since apples contain a lot of acid, they can be neutralized by treatment with soda so as not to change the pH of the soil (Pure Decorexpo - 2020).

Following the transformation of apples into juice, waste is obtained which is a rich source of dietary fibers (cellulose, hemicellulose, pectins, lignin), minerals, phenolic compounds and simple sugars. Apple waste can be used for the recovery of bioactive compounds and their use.

The tescovin resulting from obtaining apple juice can be used for animal feed, for obtaining pectin, for the preparation of pectolytic enzymes (it is part of the development medium for Aspergillus niger) and, mainly, for obtaining marmalade and vinegar. The simplest way to use apple pomace is for animal feed both fresh and dry, plain or mixed with

other fodder. It can also be used to obtain chemical products and the production of biofuels, animal feed or compost production (Bhushan et al., 2008).

In the manufacture of vinegar, you can use pomace but also other manufacturing waste, such as: apples rejected during sorting and the water resulting from washing the machines used to obtain apple juice (Dabija & Hatnean, 2014).

The obtained apple cider vinegar is used in the food and pharmaceutical industry as well as cosmetics. It has antimicrobial, antioxidant, anti-inflammatory, antidiabetic and antihypertensive properties. It contributes to improving the taste of food and aids in digestion (Kalaba et al., 2019).

2. Methods and materials

When obtaining the apple juice I will use the following apple varieties: Starkrimson, Golden, Ionatan, ReD Topaz, Rozela, and Sirius. The apples were harvested from our own orchard (orchard located in the Dâmboviței Valley), the autumn harvest of 2022. 50 tons of apples were obtained, of which 35 tons were sold for consumption, 13 tons were redirected to obtain the juice of apple and 2 tons had visible defects: broken points or impact marks. From the 2 tons, one ton was crushed and put to obtain compost (apples with damage points) and one ton was sold to obtain traditional Romanian alcoholic drinks "țuica" (struck apples).

After obtaining the juice (figure 1), the apple tescovina resulted (figure 2).

Figure 1. Apple juice

Figure 2. Tescovina from apples

In figure 1. we can see how the juice was packed, in the Bag in box system which is appreciated by consumers because it is cheap and from the point of view of sustainability: it allows a high liquid content and little packaging, the material is light and thus the system it is easier to use and transport, it provides a sterile environment and thus the juice is preserved for a long period of time (over 1 year), they can be stored on the shelf without refrigeration.

The amount of pomace was calculated by determining the pulp content remaining after juice extraction. In order to obtain the juice, the apples were chopped, then the juice was separated from the 3-chestnut with the help of the hydropress (Figure 3).

Figure 3. Hydropress

This press is used for fruit but can also be used for vegetables. It presses through the mains water pressure which must be max. 3 bars. It is made of food grade stainless steel and the legs are made of steel. I chose the version with painted steel legs.

Operation: the water helps to inflate the bellows inside the press and thus will press the mince evenly towards the walls (Figure 4):

Figure 4. Action of water in Hydropress

The yield of apple pressing is up to 70%, which means that approximately 70 kg of juice is obtained from 100 kg of apples.

The press can be turned over so we can easily remove the cake after pressing.

It is equipped with a manometer that helps to observe the water pressure in the bellows, and an overpressure safety valve.

Length: 800 mm
Width: 870 mm
Height: 1300 mm
Weight: 64 kg (Presa mobile, 2023).

Tescovina represents up to 38.7% of the amount of processed apples. In table 1. we have the amount of pomace resulting from the processing of apples (by variety) in order to obtain apple juice. It is observed that the largest amount of pomace remains after processing Rozela apples.

No. current	Variety	Volume obtained ml/kg	The amount of tescovina mg/kg
1	Golden	623	377
2	Sirius	650	350
3	Starkrimson	617	383
4	Jonathan	650	350
5	ReD Topaz	627	373
6	Rozela	613	387

Table 1. The amount of pomace resulting from the processing of various types of apples

Determination of the pomace content resulting from the processing of 100 kg of apples belonging to the Sirius variety. To determine the amount of pomace resulting from obtaining apple juice, we also calculate the amount of losses until obtaining it:

- in the sorting operation

M1 apple = M2 apple + P

M1 apple - the amount of apples used in processing
M2 apple - the amount of apple after sorting
P- the losses
100 kg = 98 kg + P
P = 100-98 = 2 kg
- at the shredding operation
M2 apple = M3 apple + P
M2 apple - the amount of apples after sorting
M3 apple - the amount of apple shredding
97, 98 kg = 98 apple + P
P = 0.02
- at the pressing operation
M3 apple = (Gross apple + Mtescovina) + P
Gross juice - the amount of juice resulting from pressing
Pomegranate - the amount of pomace
P = 97.98 - (64.3 +33.68)
P= 0 (we have no losses)
By processing 100 kg of Sirius apples, we obtain 33.68 kg of tescovina.
In Figure 1. We observe possibilities for capitalizing the pomace resulting from the apples taken in the analysis. This resulting pomace can be used as follows:
- in the manufacture of vinegar (Kalaba et al. 2019) (figure 7.) – variant 1 ;
- for fodder purposes (Bhushan et al., 2008) (figure 8.) – variant 4
- in the form of compost (Bhushan et al., 2008) (figure 9.) - variant; 6
- obtaining pectin (Canteri-Schemin et al, 2005) - variant; 5

- as a substrate for obtaining organic acids, enzymes, pigments, unicellular proteins, ethanol, beverages (Bhushan et al., 2008);
- when obtaining the marmalade (when the spine of the apple has been removed) (figure 10.) – variant 2

- by drying, as food, mixed with cereals (Cește et al., 2022) (figure 8.) – variant 3

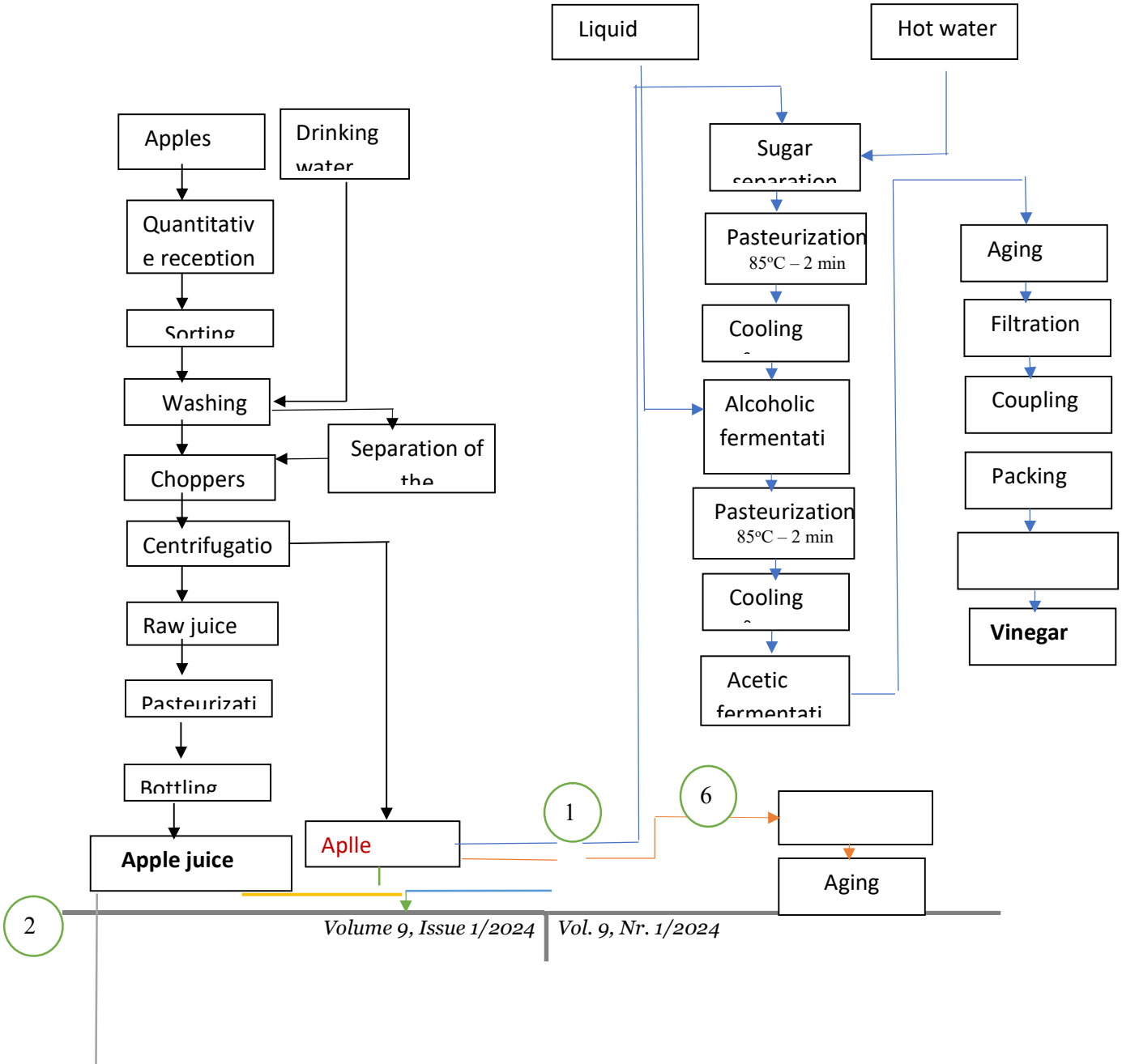
Figure 7. Vinegar

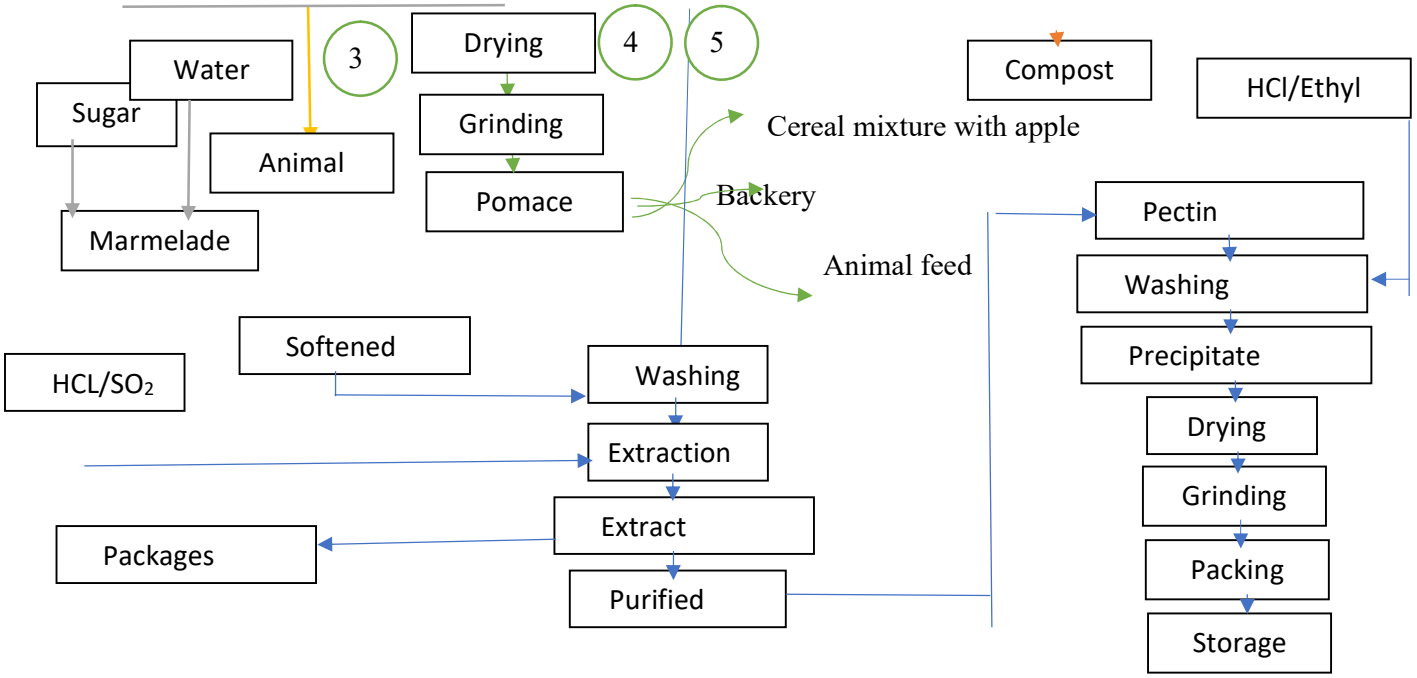
Figure 8. Pomegranate dried

Figure 9. Pomegranate from pomace for compost

Figure 10. Pomegranate marmalade

Figure 8. Technological scheme for processing the pomace resulting from the processing of apples in order to obtain apple juice





After obtaining the pomace, if we don't have time to process it immediately, it is pressed in tubs/basins to release the air and to be able to store as much as possible, yeasts are added in the form of mayo and left to ferment (it can be kept like this and 6-8 weeks). If the pressing is done well, the losses in alcohol will be small and thus a superior alcoholic drink is obtained.

3. Results and discutions

It is noted that we can use the gooseberries for various purposes, depending on the harvest and the price of apples that year. A variant of the use of the gooseberry is to subject it to the drying process. We dried it in the oven with the door slightly open at 120 0 C. The obtained product was ground and used in food mixed with cereals and an improvement in the taste of the cereals and an acceleration of the intestinal transit due to the high fiber content were found. The obtained powder can also be used to obtain bakery products, improving their fiber content and the taste is pleasant. That is why it is recommended to consume this product for people who suffer from a slow transit. Tescovina can be dried by the convective drying process. The temperature of the heating agent influences the drying time of the pomace obtained from obtaining apple juice. Research shows that if the temperature of the thermal agent is increased by 20 degrees Celsius, the drying time is reduced by more than 14% in the first period and later by more than 45% (Cește et al., 2022).

When we don't have the necessary resources to capitalize on the quince. The pulp resulting from obtaining apple juice can be used for animal feed or in the production of compost. An improvement of the soil was observed by the application of compost obtained from apple pomace. According to the soil analysis (the analysis was carried out by Hibrid SRL), the potassium content has increased, which is very necessary for the plant because it helps to improve the quality of crops. Potassium increases the resistance of the apple to diseases and increases the shelf life of the fruit. Composting is carried out either in the open air or in protected environments and has a great potential for transformation and management of the obtained remains. Over time, the compost turns into humus.

This means that it can be done either on the surface, placed directly on the ground in autumn, or composted in piles, with the addition of lime and limestone to stimulate fermentation and to neutralize the acidity of the pomace. It helps to revitalize poor soils and plant growth. Compost does not require money and is beneficial for the environment. The properties of properly obtained, stable and mature compost:
- helps maintain soil moisture, reduces the amount of water used for irrigation by up to 34%;
- represents a source of macro and micronutrients;
- helps to recycle plant residues;
- helps to grow microorganisms and aerate the soil;
- reduces pollution from landfills;
- helps to neutralize the pH in the soil

Obtaining pectin from apple pomace: pectin is used in the food industry as a functional ingredient due to its properties to form aqueous gels and can be used in the preparation of jams and jellies, in fruit preparations, various fruit drinks, fruit juices and products dairy products. In order to have a higher yield, it is recommended to use apple flour instead of gooseberries as such. Researchers recommend for a better yield the transformation of the pomace into apple flour and then the extraction of the pectin (Canteri-Schemin et al, 2005).

Tescovina can be boiled with an addition of water (2%) and sugar, bottled hot in jars and we get marmalade. This well-preserved must have a color close to that of apples and a pleasant smell of alcohol. Tescovina with signs of deterioration must be subjected to chemical analysis (alcohol), in order to establish the usefulness of the processing.

4. Conclusions

Tescovin resulting from the processing of apples in the form of juice is valuable due to its content in substances effective for the human organism. It can be processed in various forms, but it must be taken into account to process it in time to be efficient for each variant chosen. When different varieties with different tastes and aromas are used, they are also transmitted to the pomace, influencing its quality. Losses during transport, storage, processing and losses due to improper use of apple stocks must be avoided. Apples must be sorted as best as possible for sale, immediate transformation into juice and storage for a certain period of time.

References:

1. Bhushan, S., Kalia, K., Sharma, M., Singh, B., 2008. Processing of apple pomace for bioactive molecules. *Sample our Bioscience Journals*, pp. 285-296.
2. Canteri-Schemin, M.H., Fertonani, H.C.R., Waszczynskyj, N., Wosiacki, G., 2005. Extraction of pectin from apple pomace. Food science and technology. *Arm. arch. biol. Technology*, 48(2).
3. Cesko, T., Dicusar, G., Ghendov- Moșanu, A., 2022. Kinetics of the drying process of apple pomace by convective method. *Perspectives and Problems of Integration in the European Space of Research and Education*, 9(1).
4. Crucirescu, D., 2021. Arguing the need to produce the acidifier from apples and obtain it. In: Technical-scientific conference of students, master's and doctoral students, March 23-25, 2021, Chisinau. Chisinau: Tehnica-UTM, 2021, Vol. 1, pp. 413-416.
5. Dabija, A., Hatnean., C.-A., 2014. Study concerning the quality of apple vinegar obtained through the classical method. *Journal of Agroalimentary Processes and Technologies*, 20(4), pp. 304-310.

6. Eremei, A., Prisăcaru, A., 2022. Using grape pomace to create functional products. In: Technical-scientific conference of students, master's and doctoral students, March 29-31, 2022, Chisinau. Chisinau: Tehnica-UTM, 2022, Vol.1, pp. 520-523.
7. Kalaba, V., Marjanovic Balaban, Z., Kalaba, D., 2019. Antibacterial activity of domestic apple cider vinegar. *Agrofo*r ,4(1).
8. Mobile press, 2023. *Home.* [online] Available at: <https://presa-mobila.ro/> [Accessed 11 March 2024].
9. Pure Decorexpo, 2020. *Home.* [online] Available at: <https://pure.decorexpro.com/ro/sovety/yabloki-v-kompostnuyu-yamu.html> [Accessed 11 March 2024].