

## SUSTAINABILITY IN APPLE JUICE EXTRACTION TECHNOLOGY

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**Abstract:** Sustainability has become a priority for all food producers, the aim is to constantly improve quality in accordance with market requirements that are constantly changing. Consumers want safe food products, that's why a lot of standards and norms have appeared in this regard. Consumer preferences regarding the concept of quality may differ from one consumer to another, being influenced by economic or social aspects, by the environment in which they lived, what they were taught to consume or how each perceives the quality of products. Some choose the products according to the price, others according to the way of presentation or follow the brand/mother, others according to the organoleptic qualities. It is desired to apply sustainability in the technological process of obtaining apple juice. Access to a safe and nutritious natural juice that ensures the health of the population. This can be achieved by: developing a technological process oriented towards the efficient use of natural resources and preserving biodiversity, enriching the human diet by developing a wide variety of aromas, tastes, textures, enriching juice with biologically active substances, healthy working conditions, packaging in safe conditions, without additional generation of waste, reuse of waste resulting from processing (borhot - jams/sweets, rotten apples - compost), efficient supply of food along the food chain and to the consumer, healthy working conditions.

**Key words:** apple juice, sustainability, quality.

**JEL Classification:** L66, I15.

### 1. Introduction

This paper proposes the importance of ensuring sustainability in the production of apple juice by making producers responsible and providing correct and complete information to consumers. The importance of producing quality products has increased significantly lately. Quality together with permanent improvement in correspondence with the constantly changing consumer demands is a priority in ensuring sustainability. It tries to meet the demands of consumers without affecting the ability to satisfy future generations. We seek a sustainable development in harmony with the environment through the proper management of the resources it offers us (Pamfilie et al., 2016).

The objectives pursued regarding sustainability are of major importance for producers but also for the other parties that come into contact with them. The technology of obtaining the products must be thought of in the long term so as to satisfy the requirements of the parties involved, ensuring the same importance to both human resources, the balance of the society in which my business develops but also the environment (Ganescu, 2012).

Consumer requirements are oriented towards the nutritional value of food and how it affects health and normal functioning of the body. The choice of apples, the recipe for obtaining juice is made according to consumer preferences.

Apples have a high energy value that sometimes exceeds 85 calories/100g. In the fresh state they contain a significant amount of sugars (7-17%), especially simple sugars that are easily assimilated. Apples contain organic acids, especially malic acid (0.16-1.30%), pectic substances (0.5-0.6%), vitamin C (20-40 mg%), vitamin A (0.17- 0.45 mg%), vitamins B1, B2, biotin, B6, pantothenic acid. A number of 45 mineral salts have been identified in apples. The content of apples in nutrients and aromatic substances means that, in addition to their nutritional value, apples also have therapeutic value, which is why they are present in the diet of healthy people and in dietary regimes. Consumed for breakfast, apples have an

important role in preventing colon cancer because they help to clean the colon. They also have a great absorbing power of toxins. Apples help to eliminate uric acid, being recommended for people with arthrosis, obese people and rheumatics, they are recommended for treating infantile diarrhea, they are means of fighting against hypertension. To enjoy these properties of apples, we must consume them fresh. This is possible because we have apple varieties to satisfy all tastes, the ripening is periodic (summer, autumn and late autumn varieties) and they can be kept for a long time if their storage is done in a warehouse, in the cold or in a controlled atmosphere (Chirla, 2008).

There are some apple varieties that become good for winter consumption. Unlike other fruits, apples have the advantage of being better transported and stored better than the fruits of other species (stones). These fruits can be processed in the form of jam, marmalade, jam, cider, compote, juice, etc. They are also the basis for other types of marmalade, juices, etc., due to their high pectin content.

The apple adapts very well to the temperate climate, withstands the winters characteristic of the temperate climate better than any other tree species and adapts well to a wide range of soils. Apple plantations in the vicinity of cities, but especially around houses, exert a favorable influence on the climate, which is felt in terms of temperature, humidity and air purity. Apple orchards are also of particular importance through the contribution they bring to increasing the national income and the farmer if they respect the planting conditions, irrigation, anti-hail nets, etc. From an intensive apple orchard, an equivalent value of about 5 ha cultivated with cereals is obtained (Chirla, 2008).

The choice of apples is made according to the sensory properties, those that give consumers pleasant sensations are grown and kept for consumption. Before choosing the right variety for planting, the apples are analyzed according to size, appearance, color, shape, consistency, juiciness, aroma and taste (Banu, 2007). After the sensory analysis, the fruits are analyzed from the point of view of nutritional and energy value. The authenticity of the variety is followed to identify the variety if it corresponds to the requirement. Regarding the color, consumers prefer intensely and brightly colored apples, with yellow, red or green skin and the skin must be glossy, without cracks, wrinkles, marks from insect attacks, marks due to hail or stains from non-compliance with the scheme treatment. The apple pulp must be crispy, juicy and the taste according to consumer preferences. Some prefer sour taste, others sweet - sour, sour - sweet - aromatic, sour - aromatic or sweet - aromatic. That's why we need to know well the varieties of apples and their properties before we plant them. (Maleca & Chihai, 2013).

Ripe apples are used for consumption and when obtaining juices, when the sensory value reaches the maximum value. Apples that have not reached maturity cannot be used for consumption or to obtain apple juice, they are directed either to obtain acidifier or are left on the ground as fertilizer (Crucirescu, 2019).

In our country, the apple tree is planted at the beginning of autumn or in the first months of spring. But autumn planting has the advantage that the tree starts growing earlier in the spring. But if the autumn is dry and the area is one with big frosts during the winter then it is recommended to plant in the spring. Pits are dug or made with the help of the special drill when we want to start planting because the plant needs to benefit from soil moisture. The size of the pits is made according to the roots of the plant. After the holes have been made, fertilization takes place when planting, this fertilization can also be applied when we prepare the land for planting. Fertilization is done with very well fermented manure, super phosphate and potassium salt, the amount of these products is chosen according to the results of the soil analysis. The roots should not be placed directly on the fertilizers, so it is recommended to put a little soil. After planting the tree, a hole is made around it like a "basin" to keep the

water and it is watered (Chira & Pașca, 2008). Regarding the soil, the apple tree is not a very demanding species that requires certain hard-to-find soils, they prefer loamy or loamy soils mixed with sand or clay, chernozems, forest soils. It is good that there has not been an orchard on the soil chosen for the establishment of a culture. The long culture produces the loss of the physico-chemical properties of the soil and the decrease of nutrients. After the orchard, it is good to cultivate cereals for a few years because they lead to the improvement of the nutritional qualities and the increase of the resistance of the soil against pests and diseases (Dabu, 2007).

The temperatures required for apple development are between 10 and 30 degrees Celsius. It also withstands lower temperatures (freezing), but not when it enters the vegetation.

After planting, the tree trunk is covered with a special net that protects the root against rodents and wild animals (deer). In the spring after vegetation, dig around the trees to remove weeds and destroy the crust so that water can penetrate more easily. Care must be taken that the excavation is not too deep so as to destroy the roots. The shoots that grow on the tree stem are removed. Disease and pest control is carried out to have a healthy tree, healthy foliage. The apple naturally forms its own crown. Through the work of forming the crown, we manage to have skeleton branches and fruit branches so that we have maximum productivity (Chira & Pașca, 2008). After we carry out the work of cutting the trees, their volume is reduced and thus the penetration of the sun's rays is improved, which is an important factor for the development of their fruiting (Balan, 2015).

After planting, fruit trees do not consume a large amount of nutrients from the soil, but during growth, their lack reduces productivity. After analyzing the soil, the need for fertilizers is established so that the plant benefits from everything it needs to develop normally (Grițcan et. al, 2016). The basic fertilization is done with manure, phosphorus and potassium, and during the vegetation period, in addition to phosphorus and potassium, apple trees also need nitrogen.

As part of the plantation maintenance works, its cutting is also included. The apples are cut according to the variety and the chosen culture system. During the period of vegetative rest, cuttings are made for plantation formation, maintenance, and fortification. The first time are cut the weak branches, which grow close together, which do not bear fruit, the branches which grow slowly and hang down (Balan, 2020). Once the trees start to produce, the thinning of the fruits must also be done, this can be done chemically when the trees show a lot of flowers and the conditions during flowering are favorable for fruit setting and thus quantitative and qualitative fruits can be obtained year after year.

Another important thing is the irrigation of the plantation, this is done according to the year, if it is dry or not. The most used irrigation method is drip irrigation (Figure no. 1).

Hail can destroy both trees and fruit, so anti-hail nets are recommended. They protect very well from hail but also from burns in very hot periods. Late frosts can destroy that year's apple production, so we use fumigation (Cimpoies, 2014).



Figure no. 1. Drip irrigation system

Apples can be stored for a long period of time without quantitative loss or qualitative deterioration. We find them for sale, for consumption, all year round. For this, the apple must be harvested when it has reached maturity, it must not be hit during handling during picking, packaging, transport, storage and in its route the hygiene conditions must be respected. If we have a large production and do not have time to turn the apples into juice, the most efficient method, but at the same time more expensive from a financial point of view, is to store the apples in cold rooms and in a controlled atmosphere. (Udriste et al., 2018). Apples in warehouses that keep low temperature, refrigeration temperatures 0-4 0C are stored in pallets of different sizes, made of plastic or wood.

During fruit storage, the physiological and biochemical processes in them continue depending on the storage conditions. It has been shown that fruits improve their organoleptic properties by respecting temperature, humidity and hygiene conditions (Gaviuc, 2017). By using a controlled atmosphere for apples of the Golden variety and in parallel with the usual atmosphere, a negative change was observed in the appearance of the fruits stored in the normal atmosphere, they shriveled, their moisture decreased (they are no longer juicy), they are no longer crispy, their quality has decreased. In the case of controlled storage, the fruits did not change their appearance. In figure no. 2 we observe apples stored until March, they are juicy and look like during harvest. And the taste of those stored in a controlled atmosphere is much more appreciated compared to those stored in a normal atmosphere. We can also discuss consistency.



Figure no. 2. Apples in March kept in warehouses with controlled atmosphere

In order to benefit from the positive effects of storage in controlled atmosphere (figure no. 3 and 4), the stored fruits must be picked during the optimal harvest period, be healthy, picked and transported in hygienic conditions.



Figure no. 3. and 4. Warehouse with controlled atmosphere in the Valea Dămboviței area

If the hygiene conditions during picking, transport, and storage are not respected, the fruits can be contaminated with various microorganisms. Fungal infection causes spoilage of apples during storage. Identifying and removing this contamination prevents losses during storage. Methods for identifying pathogens have been sought. In addition to agents of a fungal nature, microtoxins and volatile compounds can also occur. The best known microtoxin found in apples is patulin. In our country there is a study that helps to identify sixteen fungal agents. The removal of diseases during storage can be done through the new molecular techniques discovered (Udriste et. al., 2018).

To improve storage in a controlled atmosphere, it is recommended to use continuous refrigeration treatment from apple picking to storage. This system presents the advantage of the rapid release of heat from the harvested fruits and the prevention of transpiration (causes dehydration of the fruits through water loss), thus increasing the storage period and maintaining high quality (Bodiu, 2015).

Depending on the storage temperature, the vitamin C in stored apples changes its concentration. This decreases as the temperature increases. And the amount of sugars in apples increases during storage. It has been shown that apple varieties react differently to applied temperatures (Maleca & Chihai 2013).

## 2. Materials and methods

We use apples from our own plantation in the Voinești area, Dâmbovită (Romania). The aim is to use some methods of planting, harvesting, technological process of obtaining the juice so as to ensure sustainability. Fruit processing produces waste such as peel, seeds and other by-products such as apple pulp which contains a large amount of pectin, cellulose and hemicellulose that can be used to obtain other foods, the total amount of waste during the obtaining of apple juice differs depending on the variety of apple used, this amount varies between 10 and 30% of the weight of the fruit (Vodovic et al., 2020). Byproducts contain compounds that are nutritionally valuable such as mineral salts, polyphenols, dietary fibers, vitamins, enzymes, etc. (Galanakis, 2020).

The right apple variety is chosen so that we get a good yield and the consumer is satisfied. To improve the nutritional value of pasteurized apple juice, add honey, pollen or royal jelly.

In the fruit juice industry, large losses are observed of:

- Energy (storage, washing, juice pasteurization)
- Water (cultivation maintenance, washing of fruits, machinery)
- Food (apple mince)

It aims to reduce these losses to a minimum and search for optimal solutions to ensure sustainability in the apple juice industry.

### **3. Results and discussions**

By ensuring sustainability when obtaining apple juice, the side of economic development, social development and environmental conservation has been improved. These dimensions of sustainable development are key to securing the future of the fruit juice sector.

Economic development: since I own an apple orchard, a sustainable business in this field is desirable. The business consists of developing a production line of 100% natural apple juice and other fruit juices based on apple juice in the future from the remaining borhot developing a jam/sweets business.

Social development: I aim to get a high quality juice with as much nutritional value as possible so that potential customers are satisfied with the juice quality, taste and price, so that they prefer my juice recipe.

Due to the seasonal ripening of apples, there is an imbalance between the production and consumption of these fruits fresh. One solution is to store the fruit in a controlled atmosphere warehouse to produce fruit juice all year round. But the cost of this deposit is very high, so to begin with I will choose the option to use the fruits for consumption immediately after harvesting and to turn the remaining ones into juice. The juice will be preserved so that it does not lose its properties (to have a nutritional value close to that of freshly squeezed juice) until the next fruit harvesting season. The 100% natural fruit juices will be preserved with the help of natural preservatives (honey, propolis, royal jelly and essential oils) and by light pasteurization so as to obtain a nutritional value close to that of freshly squeezed juice.

There are many orchards in my area (Voinești, Dâmbovița, Romania) but many apple growers have secured another source of income. Interest in apple culture decreased, orchards began to stop producing, grow old and disappear. I want to rekindle interest in apple culture.

Creating a good, functional environment, free of pollution and waste, in which life can unfold in all its glory:

As producers as well as consumers of 100% natural fruit juices, we each have our well-established role in supporting the transition to the natural economy.

Regardless of the intellectual resource we have or the level of income and where we live, the health and well-being of all of us depend on the environment (Ivana S., 2019).

Natural means choosing something that frees you from the daily grind and reconnects with authentic feelings. The products made from our own plantation, with the choice of appropriate varieties of fruit, help us achieve a harmonious connection with the environment. I made the plantation and I will capitalize on the fruits out of love for nature and at the same time I will promote the values of sustainability, these values should be assimilated by every person or fruit juice factory. Modern techniques help to promote a responsible climate and we are not affected by the consequences of pollution. We will not waste potable water when washing the fruits and the residues resulting from the processing of the fruits (the pulp) are sent for recovery. The rest of the residues: leaves, branches, defective and rotten apples can be used as compost.

#### 4. Conclusions

In order to ensure sustainability in the production of apple juice, the following is taken into account:

- Access to a safe and nutritious natural juice that ensures the health of the population.
- Development of a technological process oriented towards the efficient use of natural resources and the conservation of biodiversity.
- Enriching the human diet by developing a wide variety of aromas, tastes, textures;
- Enrichment of juice with biologically active substances.
- Healthy working conditions.
- Safe packaging without additional waste generation
- Reuse of waste resulting from processing (borhot - jams/sweets, rotten apples - compost).
- Efficient supply of food along the food chain and to the consumer.

#### References

1. Balan, P., 2020. *Apple growth and fruiting according to tree cutting system in super-intensive culture system*. In: Theses of the 73rd scientific conference of students. Chisinau: Agrarian University.
2. Balan, V., 2015. Technologies for the intensification of apple and cherry culture. *Magazine of Science, Innovation, Culture and Art "Akademos"*, 3(38), pp. 82-87.
3. Bodi, A., 2015. Optimizing the preservation and storage system of easily perishable products. *Theses of the 68th scientific conference of students and master's students*. Edition 68, T, May 20, 2015, Chisinau. Chisinau: Agrarian University.
4. Chirla, L., Pașca, I., 2008. *Apple Culture*. Bucharest: Ed. M.A.S.T.
5. Cimpoiș, G., 2014. Ensuring the quality of fruit products. *Science, Innovation, Culture and Art Magazine "Akademos"*.
6. Crucireșcu, D., 2019. Apple fruits in the early stage of ripening - raw material for obtaining the natural acidifier. *Technical-scientific conference of students, masters and doctoral students*. 1, March 26-29, 2019, Chisinau. Chisinau, Republic of Moldova. pp. 505-508.
7. Gănescu, M.C., 2012. Corporate social responsibility, a strategy to create and consolidate sustainable businesses. *Theoretical and Applied Economics*, Volume XIX (2012), 11(576), pp. 93-109.
8. Galanakis, C., 2020. *Valorization of Fruit Processing By-Products*. Cambridge, MA, USA: Academic Press.
9. Gaviuc L., Bujoreanu N., Bejan N., Harea I., Long-term storage, quality and gustative harmony of apple fruits. *Advanced technologies for cultivation and protection of crop plants*. Section IV. pp. 270-272.
10. Gaviuc, L., Bujoreanu, N., Bejan, N., Harea, I., 2017. Long-term storage, quality and gustatory harmony of apple fruits. *Genetics, physiology and plant breeding, international scientific conference*. Edition 6. Chisinau: Tipogr. "PrintCaro", 2017, p. 270-272.
11. Grișcan, S., Dadu, Z., Polihovici, L., Crivaia, P., 2016. *The study on foliar fertilization in apple culture. Integration through research and innovation. Natural and exact sciences*. Chisinau, Republic of Moldova. pp. 124-127.
12. Ivana, S., 2019. *Eco-innovation, Sustainability, Regeneration. Sustainable development strategies in disadvantaged mountain areas in Romania*. Bucharest: Ed. Royal Indigo.

13. Maleca, T., Chihai, M., 2013. The degree of modification of some biochemical indices depending on the applied storage temperature. *Scientific Annals of the Cooperative-Commercial University of Moldova*, 12(2), pp. 193-197.
14. Maleca, T., Chihai, M., 2013. Evaluation of the organoleptic properties of new apple varieties. *Scientific Annals of the Cooperative-Commercial University of Moldova*, 11(2), pp. 376-380.
15. Pamfilie, R., Bobe, M., Cristescu, L. and Toma, M.A., 2016. Innovative Food Quality Models - Developed as an Interface for Modern Consumers and Sustainable Business. *Economic Amphitheater*, 18(43), pp. 663-674.
16. Udriste, A.A., Ciceoi, R., Badulescu, L., 2018. Methods of early identification of phytopathogenic fungi affecting apples during storage. *Fruit Growing Research*, Vol. XXXIV, pp. 147-152.
17. Vodovic, S., Tepic Horecki, A., Vladic, J., Sumic, Z., Gavaric, A., Valkula, A., 2020. Apple. *Valorization of Fruit Processing By-Products*, Chapter 2. Amsterdam: Elsevier Inc.