

Technical Solutions for a New Product: Red Apple Juice

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ABSTRACT

A 'Wijcik'-called, natural mutation of the 'McIntosh' kind of apple, with red pulp and light red juice, was discovered in the 50ies. It is characterized by its fruits growing very close to the trunk. The crown of these columnar tree is about 3-4 meters long, with a diameter about 20-30 cm. The advantage of this kind of tree is that tree-cut is mostly unnecessary, tunnel-spraying equipment can be used and harvesting maybe fully mechanised. This new product, combined with the new kind of cultivation, requires for new technologies for growing and harvesting. While labour becomes the limiting factor of production, handwork is impractical and thus a new method for mechanical harvesting in columnar apple growing is needed. For this purpose, a mechanical grape harvester, adapted for these special apple trees by modifying the harvesting head, is used to prove the suitability of this technique in pomiculture. Furthermore, tunnel spraying equipment is adapted for this purpose and tested as well, in order to enable drift and loss reduction in plant protection.

Keywords: apple trees, mechanical harvesting, columnar crown, tunnel spraying, Germany

1. INTRODUCTION

The German fruit drink industry insures its commercial effectiveness by creating new, innovative products. For apple juice, however, there is still room for improvement for new, interesting products with a high nutritional value. The big companies creating apple juice stand in front of a big dilemma when it comes to creating new and unexplored products. The expectations for such a product are:

- It needs to be a new and consumer attractive product
- The feedstock for the final product have to be colour and protein stable
- The feedstock has to be grown close to the production plant
- The raw materials should be at a plentiful or trustworthy quantity
- The raw materials should be cheap to produce and, if possible, leave a advantageous "carbon footprint" behind

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- To keep the production sustainable, a document stating all of the production processes, including feedstock production, should be provided



Figure 1. red apple juice

2. MATERIAL AND METHODS

Apples with a red pulp produce a light to middle red juice (Figure 1). This is very attractive and above all would decrease the amount of food colouring used in the production. However the information on the nutritional value of these apples have not been surveyed yet, which can change due to the climatic conditions, storage, and colour stability while being produced. At the same time, growers would be in a win-win situation, if the cheap production follows through. The harvest by hand would be too labour intensive.

This could be solved by a naturally developed growth of the apple tree, the columnar style of growth. Therefore experiments with different styles of tree forms are accomplished to find technological solutions for the fruit juice industry and to develop an economical cultivation systems to secure the production. The single goals are:

- Type screening of existing red pulp types, process to pure and clear juice, apple cider, and sparkling apple juice as well as apple sauce
- Analysis of the nutritional value and colour components before, during and after the pressing and bottling process
- Possibility to inhibit the activity of native quality decreasing enzymes
- Analysis of the aging behaviour throughout various storage methods, temperatures, and storage duration
- Influence of inter annual climate changes on the nutritional and colour value of the ingredients
- Development of a tree protecting mechanical harvesting process for columnar style apple trees, but also to influence the breeding process
- Development of a tunnel spraying system for agent saving and drift reducing plant protection
- Investigation on GPS- and RFID transponder systems to implement the quality Management systems in combination with the developed technique.

This will be accompanied by economical analysis of cultivation systems, based on columnar apple varieties in consideration of potential technological solutions, and will result in the following economical possibilities:

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- For the fruit juice industry qualitative and quantitative results to produce a carefully treated and colourfast apple juice in order to get an attractive product
- For the harvesting and plant protection equipment manufacturers to make a statement of the technological possibilities for the cultivation system of columnar apple types and therefore create new markets
- For the grower a new competitive possibility to produce qualitative raw goods for the beverage industry
- For the beverage industry to create new and qualitatively rich apple juice types
- For the entire beverage industry the possibility to purchase apples for juice close to their habitat, for this in turn will lead normal apple types to be grown in the same way
- For the growers and the beverage industry to create a QM system to secure the documentation all of the processes starting from the planting of the trees

There is a worldwide change in the development of big apple trees in the early twentieth century to the dwarf and columnar form of today. This changed the quality of the apples by providing all of the apples with equal amounts of light. To others, this was the base for higher productivity, as well as a better harvest due to economical work advantages. But, the seasonal and still very high need of foreign workers is creating still a problem for the German fruit producers and is a challenge for the competition between producers. Therefore the apple, worldwide the third most important and in Germany the most important fruit, the need of growing systems with very little need of maintaining, is high and very important for the competition of the German fruit producers.

Particularly drastic is the importance of the mechanization in the pressed fruit juice industry, which is traditionally part of the extensive used orchards in Germany. The Harvest volume in these orchards is less each year, because of the limited mechanization. Therefore the owner of the extensive used orchards will be less every year as well. Another part comes from non-sellable apples from storages, or is imported from east Europe. According to statements of “Naturesaft Sachsen” the supply has to come in 2007 out of a radius of <400 km to make it economically worthwhile. Because of rising energy and transportation costs, this radius might be even smaller today. Therefore the production is jeopardized for high-end apples juice. A new option would be to introduce a natural breed of an apple “McIntosh” from Canada in the 1950’s. This shape is called “Wijcik” and shows the so called columnar growth, meaning the trunk has only a few side branches, with a lot of blossoms at the end of each branch. The resulting fruits will grow close to the trunk. The plant has only 20 – 30 cm in diameter at a final height of 3 – 4 meters. This means the fruits have all the nutrients at its disposal. First of all this increases the harvest amount per orchard. Secondly this brings work related and economical advantages and could result in less manual labour and therefore a higher competitiveness for the producers. These results are:

1. Low tree pruning costs
2. The harvest could be fully mechanized
3. Necessary spraying of fertilizer could be done in a tunnel system, and would minimize the drift
4. The thinning could, if necessary, be done mechanical (i.e. Tree Darwin)

These work economical advantages of fruits could be done and would be very efficient for the fruit juice industry.

3. RESULTS AND DISCUSSION

In the 1980's cross breeding with a wild apple, which had red pulp flesh, and a columnar form breed was done. The result was an apple called "Maypole". On the base of this red fleshed, columnar apple tree cross breeds, an example shown abloom in Figure 2, were done to bring it up to a better standard, on the other hand to get a good sugar/acid relationship. Simultaneously, at the State Research Institute for Viticulture and Pomiculture (LVWO) in Weinsberg, a program for cross-breeding and selections with red flesh and normal growing apple trees was researched. At the same time, this also applies to the fruits with the red meat which have the same needs as normal fruit. It must be cheaply made, this means that it will not only be cheaply produced, but also cheaply harvested and transported as well. The main cost factors in the production are, besides initial planting of the orchard, the pruning and the harvest (Schroeder, 2007). In both of those aspects, the columnar apple varieties offer the potential of savings in the production and harvest, even the change from intensive mechanical harvest or manual harvest to a more effective mechanical solution shown in Figure 3. Despite the technology of mechanical harvesting is well known from ordinary fruit juice production (Moser 1984), grape harvest and other agricultural farming, the mechanical apple harvest for juice production of columnar trees is not realized yet. Still there is the potential to increase the competitiveness in the fruit juice market by utilizing labour saving columnar cultures in connection with mechanical harvest (Schroeder, 2007).



Figure 2. columnar apple tree abloom; Figure 3. mechanical harvesting.

By using different columnar types, there is a chance for environmental friendly plant protection, meaning sustainable production. Because of the extreme narrowness of the trees, recycling technology could be effectively used. There is enough literature about area application specifically for common agricultural problems, as well as literature about mostly air stream supported application in the areas wine-, fruit- and hops- production. Due to the different needs, i.e. air stream profile, air volume or speed, the solutions are very culture specific. Because of that, there is no scientific work done in terms of plant protection for columnar apple trees, but the methods to adjust machines for culture specific needs are well known and researched at the institute in Geisenheim as part of the work for the industry and federal test facilities (Bäcker and Struck 2002).

According to the statutory obligations for food and feed business operators (e.g. EU-VO; 178/2002; 852, 853, 854/2004) and standards of trade partners (GLOBALGAP, IFS), producers have to have an exact and legally compliant documentation of the production process to get a chain oriented quality management system (Seufert and Hesse, 2008). In general this is missing in the fruit juice industry. This is an evident weak point and one can expect that in the future the retailers will have this gap closed. The documentation of all procedures in the production, in connection with QM- systems like GLOBALGAP or IFS, is part of scientific research for some time (Seufert and Hesse, 2008). In example the use of GPS on tractors and machines for work processes including the grape harvest is documented and evaluated in connection with a farm management software (Keicher and Schwarz, 2008) (Bäcker et al., 2008). Therefore PDAs with GPS receivers and the necessary software are used. The supply of a wine yard tractor with the

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ISOBus-system is supposed to register the attachments and automate the documentation of all work procedures. To date, this concerns only the grape harvest and is missing completely in the fruit juice production. The mechanization of all work procedures in the fruit juice production opens the possibility of an effective and gapless documentation similar to the one in wine production and is an additional part of a future oriented production system.

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