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The Recovery of the *Old* Limachino Tomato: History, Findings, Lessons, Challenges and Perspectives

J. P. Martinez, C. Jana, V. Muena, E. Salazar, J. J. Rico, N. Calabrese, J. E. Hernández, S. Lutts, and R. Fuentes

Abstract In this chapter we present a brief summary of several aspects related to the recovery of the *Old* Limachino Tomato, a specie cultivated in the Limache Basin located in the Valparaíso Region, Chile. What is very interesting in relation to this specie is that it disappeared completely of the market 45 years ago! We highlight both technical and commercial aspects associated with its recovery. In particular,

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the project behind this huge endeavor has returned to the table of the Chileans a fruit with high healthy and functional qualities. In addition, its strong connection with a specific territory makes it very desirable for consumers. However, issues related to the protection of the Peasant Family Farming of the cultivation area and the improvement of post-harvest quality are key to guarantee the sustainability of the business. In particular, we claim that in a sustainable agriculture development perspective, there is an urgent need to increase the tolerance of this species to salinity stress in order to increase productivity and reduce water use and fertilizers. Local rootstocks appear as a promising technology to overcome part of these challenges. Trademarks and certificates of protection are also urgent.

Keywords Limachino tomato · Peasant family agriculture · Rootstocks · Value chain

1 Introduction

In 2015, the Food and Agriculture Organization of the United Nations (FAO), founded in 1945, launched the International Year of Family Farming in order to "stress the vast potential family farmers have to eradicate hunger and preserve natural resources". According to that organization, small-scale family farming is innately connected to global food security. In addition, it preserves traditional foods and contributes to a balanced diet as well as to the protection of global agricultural biodiversity and to the sustainable use of natural resources. Finally, it represents an opportunity to energize local economies, especially when combined with policies specifically targeted toward social welfare and community wellbeing. Quantitatively, more than 90% of world agricultural exploits are managed by one person or family, producing around 80% of the world's food and occupying between 70 and 80% of agricultural lands.

In conjunction with this launch, in July of that year the Foundation for Agricultural Innovation (FIA, in Spanish), associated with the Ministry of Agriculture of Chile, opened a call for Peasant Family Farming—Valuing the Agrarian Heritage. The Agriculture Research Institute (INIA, in Spanish) in partnership with the Federico Santa Maria University (UTFSM, in Spanish), responded to this call, and won, with

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their project, "Local, health, and sensory value of the Limachino tomato[1] for peasant family farming in Marga-Marga province".[2] An important point to note is that neither Juan Pablo Martinez of INIA nor Raúl Fuentes (both of whom were advisors and leaders of the project) were completely aware at the time of the impact a modest project like this (in terms of funds) would have, ranging from the recovery of the Old Limachino tomato's role in the "once" teatime ritual in Chile to more complex—and sometimes disappointing—political impact. This make this story deserve to be attended.

To put it briefly, the project's goal was the rescue and definitive reappearance to Chilean dining tables of this former icon of the Limache watershed in the Valparaiso region: the Old Limachino Tomato.[3] INIA led the agro-technical side of the project while UTFSM led the commercial. In particular, INIA was in charge of recovering old limachino seeds from international and national seed banks and from fields inside the Limache Basin through the collecting of the seed material held in producer's hands. Besides, INIA was in charge of recovering the ancestral agronomic management of this type of tomato. UTFSM was in charge of the creation and implementation of a business model for future commerce associated with the fruit. To highlight the enormity of this challenge, our goal here was to recover and reintegrate to the market a product that had disappeared 45 years ago! All the literature on management, marketing and economic development was against us. We had neither national nor international referents or similar examples with which to begin our investigation. We had to innovate from practically zero.[4]

Although these difficulties, we learned early on that the business of the Old Limachino Tomato was not only about producing and selling a fruit with superior health and sensory traits, but also about selling a product with a strong local identity associated with a rich multicultural, intangible heritage. Above all, it was about selling a product that was (and is) loved by the people. The fruit was part of the collective imagination of many people older than 45. In other words, we learned that the key to the commercial success of the Old Limachino Tomato was in hitting the perfect note of subjectivity and emotion with the consumers along with business rationality. Having learned this lesson, it was much simpler to create our model. We made radical changes to two dimensions of the tomato's traditional commercial model: in its value proposition and in the configuration of its value chain. We realized that that the business was not about selling Old Limachino Tomato as such, but it was

[1]It refers to a variety of local tomato cultivated massively in the Limache Basin (place located in the central zone of Chile which is formed by the communes of Limache and Olmué) between 1950 and 1981 which become the main tomato traded in Chile before the appearance in the market of the long-lived varieties.

[2]For more details, see https://www.fia.cl/convocatorias-fia/ver-convocatoria/afc/.

[3]The adjective *old* was introduced to differentiate the genuine Limachino tomato from other long-lived varieties of tomatoes cultived in the Limache Basin.

[4]To the best of our knowledge, we knew some few cases of reintegration to the market of *new versions* of old products related to the automotive industry (new Austin Mini, new Fiat-600) and the music industry (new cassette; new long-play). In our case, our goal was the reintegration to the Chilean market of an old agro-product without the slightest modification.

about giving value to a rich historical-cultural patrimony of Chile. Having learned this, we decided, in a first stage, to sell the product directly, that is, without using intermediaries. The strategy was the following: once the product was well-valued by the consumers, the intermediaries would come to us and we would set the sale price. We took the risk and… we won.[5] The full implementation of the business model among the small local producers of the Old Limachino Tomato is still in development.

The project ended formally in January of 2017. It was declared an *emblematic* project by the then-authorities of the FIA. It had precisely fulfilled all its specific objectives. Today we know, in genetic terms, what is and what is not the Old Limachino Tomato. The geographic cultivation zone has been established. Over the course of the two-year of the project, 55–60,000 kg of fruit were sold at an average price never imagined by the producers, which significantly reduced the market uncertainty inherent in any innovation. Today, a long-term contract with an important international supermarket chain is currently working in order to initiate and consolidate the expansion of the product's commercialization to other regions in Chile, particularly to the capital city Santiago. In practice, the business model's proposed strategies worked.

Nevertheless, the Old Limachino Tomato's definitive return is not at all guaranteed. There are multiple and varied challenges to overcome so that the fruit doesn't return again to the tomb where it lay for almost 35 years. Among other challenges, the product's post-harvest durability must be improved. To this end, we have currently designed a strategy based on the use of rootstocks created from interspecific crosses between *S. chilense* and the salt-tolerant local tomato cultivar from Northern of Chile. According to our preliminary results, the use of this kind of rootstocks would increase significantly the lifetime of the product without altering its flavor and healthy attributes. On the other hand, advancements in biological managements of production are also needed and demanded by consumers. Creating channels to reach and conquer a younger public is another task to take on. Creating an appropriate and complete Value Chain is another one. But without a doubt, the most important challenge to overcome has to do with the design of a management model that achieves the highest level of connectedness, coordination, and commitment among the small producing business owners. Due to the complexity of the problems above mentioned, they are being tackled in collaboration with internationals institutions such as FEDACOVA (member of the European Cluster Collaboration Platform), Institute of Food Production Sciences (CNR-ISPA), the Liverpool University (from UK) and the Université catholique de Louvain, (from Belgium).

Meanwhile, in the short and medium terms, the Old Limachino Tomato still requires the cover and protection of institutions such as INIA and UTFSM. So far, both institutions, in the name of the local producers, obtained a trademark associated to the fruit and are gaining strength and momentum to obtain a certificate of protected

[5] At this point, it is worth mentioning that the attitude of the producers was rather of disbelief towards us because they had never in their lives been able to set the selling price of their products. Even worst, the price of tomatoes has always been set in the markets of Santiago, the capital of Chile.

designation of origin (PDO) for the fruit. The achievement of the latter would be a historic milestone for the Valparaiso region and for the country, as it would be the first vegetable to obtain that distinction. These efforts are being coordinated by the respective offices of technology transfer of both Institutions.

Taking everything into perspective, the business of the fresh Old Limachino Tomato is valued at 100–150 million Chilean pesos annually. If processed products (sauce, marmalade, preserves, and so on) are added to that figure, the valuation could reach one million dollars a year in a five-tear horizon. These are meaningful sums in family agriculture. However, the real underlying business of the Old Limachino Tomato will be in the returns on the intangible assets the project generated and continues to generate in the Limache watershed. Particularly, and in the words of its local government, the Limache commune and its surroundings "came back to life" with the recovery of the fruit.

In what follows, we reveal some very technical outcomes of the recovery project of the ancient limachino tomato, as well as the challenges to be overcome to consolidate its definitive return to the table of the Chileans.

2 Brief Characterization of the Old Limachino Tomato

The process of characterization of the Old Limachino Tomato started with the evaluation of productive, phenological, and morphological parameters in 13 tomato accessions gathered from international and national seed banks and from fields inside the Limache Basin through the collecting of the seed material held in producer's hands. From this evaluation, the formation of several groups were observed. Ten of the initial 13 accessions were discarded as potential limachino tomato types. One of the remaining accessions was identified as the Italian genotype *Cuore di Bue (Corazón de Buey, in spaninh),* genotype collected locally in 2015 and codified with the acronym FIALIM3. See Fig. 1. The fruit related to this accession is named "Italian-type" limachino tomato by local farmers The others two remaining accessions, one of which was collected by INIA in 1960 and the other locally (from local farmers) in 2015, were identified as the Italian genotype *Costoluto Genovese.* These accessions were codified with the acronyms SLY74 and FIALIM4 and recognized as limachino tomato of the "French-type" by local farmers.[6] See Fig. 2.

Speaking shortly, once the study of the morphological and molecular characterisation was finished, the *Cuore di Bue* and the two *Costoluto Genovese* accessions are recognised within the family of the Old Limachino Tomato. However, from an ancestral management point of view on the part of the farmers, said accessions are

[6]Strictly speaking, both species were brought by Italian immigrants who arrived in the Limache Basin at the beginning of the twentieth century. The name "French-type" is due to the fact that this variety is very similar to the Marmande variety, a French variety that arrived at the Limache Basin during the 70s and that was massively cultivated by local producers.

Fig. 1 Tomato Cuore di Bue ("Corazón de Buey")

Fig. 2 Tomato Costoluto Genovese

indeed recognised as such. From this results, the three species were grouped separately from commercial varieties and traditional varieties of European or American origin, and are currently being re-cultivated by the farmers of the Limache Basin.

On the side of agronomic management, the productivity of the Old Limachino Tomato, like any tomato variety, depends on several factors or determinants such as density, conduction, irrigation, nutrition, disease and pest control, soil, climate, among others. However, the Old Limachino Tomato's agronomic management has also some specific features that are important to be highlighted. According to the experimental data and data compiled from farmers, it was determined that the planting density of the Old Limachino Tomato is different for each type of accession: the "French-type" (FTOLT) and "Italian-type" (ITOLT). This, depending on the vigor of the respective plant. According to this criterion, our tests suggest that the planting density of the Italian-type accession should be lower than of the French-type accession due to its greater (relative) vigor. On the other hand, it was found, in practice that the adequate conduction in both accessions should be at one axis. This condition facilitates the agronomic managements made by producers, either managed outdoors or under greenhouse conditions. The outdoor conduction is carried out in an old-fashioned way, using in tutelage of "colihue" (*Chusquea culeou* in scientific terms) or wooden poles, and inside the greenhouse through the hanging of the plant through a linen cloth. Our results showed that a better functional and sensory quality of fruit is obtained at harvest in both types of tomatoes when the plant is allowed to grow only up to the fourth fruit cluster. However, in the case of the French-type (*Costoluto Genovese*) accessions, it is highly recommended to take out the big flower (named "florón"), because this organ takes away strength from the other flowers of the bunch. In general, it produces in the first cluster of this type of tomato. This management increases fruit size and the productivity. In relation to pests and diseases that affect the cultivation of the Old Limachino Tomato, they must be well managed to minimize the harmful effects they have on plants, always trying to avoid environment's contamination with chemical fertilizers, insecticides and chemical fungicides available in the market and minimizing the costs of fertilization and control so as not to affect crop productivity. The best way to control is using the Integrated Management of Pests and Diseases (Spanish acronym: MIPE), protocol oriented to reduce chemical products and increasing biological products. At this point, it is important to highlight that the ITOLT was the most unstable accession to the yield when subjected to conditions of organic management (compost) in comparison to the Long-Life Tomato and the French-type tomato. From this, it can be concluded that the French-type tomato has a higher rusticity than the Italian-type. This difference in rusticity and its effect on productivity was notoriously perceived.

In relation to the agronomic characterization, experiments carried out with the farmers of old limachino tomato in the Limache Basin show that the productivity up to the fourth bunch of the French-type limachino tomato and the Italian-type limachino tomato is around 2.0 and 1.6 kg per m^2 with 13 and 15 fruits per m^2 respectively, under optimal conditions of greenhouse cultivation. It is interesting to note that, at a productive level, the French-type limachino tomato (*Costoluto Genovese*) presents a similar productivity with respect to more commercial varieties like the Long-Lived

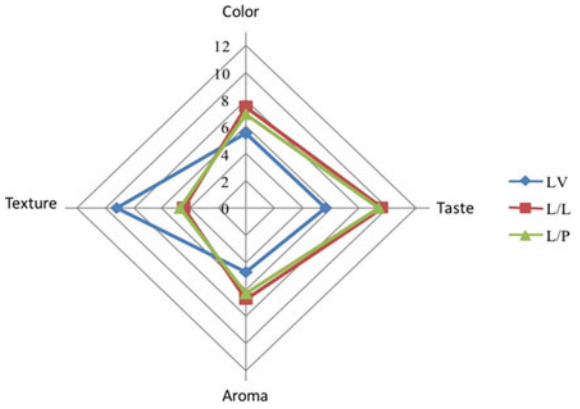

Fig. 3 Sensorial fruit quality (color, taste, aroma and texture) among non-grafted (long life variety, LV), selft-grafted (L/L) and grafted (L/P) Old Limachino Tomato plants

tomatoes. With respect to the quality of the fruit (functional and sensorial), it is well known that the importance of tomatoes as a healthy food is mainly explained by its different health-promoting compounds [21], such as lycopene, a-carotene, phenols, or Vitamin C. Currently research carrying out at INIA laboratories observes that the Old Limachino Tomato has a much higher antioxidant capacity than long-lived (LV) tomatoes on 50% [13] which, join with its unique and delicious taste and intensive red color and aroma (See Fig. 3), makes the fruit a very attractive and desirable product. However, the fruit presents a bad texture (See Fig. 3), short harvest period (one month) and low durability (5–7 days) compared to the Long-lived tomato. Therefore, it is necessary to surmounting gradually these problems in order to ensure its commercial sustainability. In line with this vision, INIA is currently studying the effect of the salt-tolerant rootstock on fruit quality at harvest and their healthy properties and fruit quality attributes after harvest in Old Limachino Tomato under saline stress, considering the importance of saline soils, environmental tendencies and global change around the world and Chile. In a sustainable agriculture development perspective, there is an urgent need to increase the tolerance of this species to salinity stress in order to reduce water use and fertilizers for agricultural production. Most of the local varieties cultivated since five decades ago were selected for yield potential under optimal conditions and they are thus lacking the key properties allowing the plant to cope with stress conditions. A promising alternative is to analyze the properties of old local varieties or closely-related wild relatives that could be used for breeding purposes. Centers of origin of tomato are located in Chile and it may thus be expected that plant material exhibiting a high level of tolerance to environmental and a high water use efficiency is still available in these areas. As far as local tomato varieties like the Old Limachino Tomato is concerned, grafting procedures can improve tomato crop productivity under various environmental conditions. The selection of appropriate rootstocks that allow the plant to cope with an abiotic stress such as salinity appears then as a priority. Halophyte plant species that could be crossed with the cultivated *S. lycopersicum* constitute a promising material for this purpose. INIA has access to a large germplasm collection of wild species and has

already initiated studies focusing on Solanum chilense, [8–10, 14, 15] a halophyte wild tomato spontaneously growing in the North part of Chile, in the salt desert of Atacama, one of the driest areas in the world.

3 Prolonging Old Limachino Tomato's Lifetime by Creating and Using New Types of Rootstocks

As said, one urgent challenge to be surmounted is related to the short durability of the fruit once harvested. More specifically, the lifetime of the fruit ranges among 5–7 days under optimal cares during transport to the place of sale and under a delicate treatment from the part of the final consumer. This weakness makes no possible the commercial expansion of the product to more populated and distant markets. Based on international experiences, INIA is currently carrying out a couple of research projects aimed to introduce the use of new rootstocks created from interspecific crosses between *S. chilense* and the salt-tolerant local tomato cultivar from Northern of Chile. Three main effects are expected once the rootstock is grafted in the plant: gains in productivity, resistance to salinity and improvements in the quality of the fruit. In particular, consumers' preferences for fruits and vegetables with high concentrations of healthy compounds is steadily increasing and, therefore, it is important to test the effect of grafting on productivity and fruit quality under salinity conditions present in the growing zone of the Old Limachino Tomato. In line with this objective, it is well known from the works of Albacete et al. [1, 2] and He et al. [11] that grafting procedures can improve tomato crop productivity and postharvest quality under different environmental conditions, such as salinity.[7] On the other hand, at the optimal growing conditions, Barrett et al. [4] observed that fruit composition and sensory attributes of tomatoes are affected by grafting. They didn't reported changes in vitamin C, soluble solids, pH or titratable acidity among nongrafted, selft-grafted and grafted plants, but he detected differences in sensory attributes such as taste, color, aroma (See Fig. 3), appearance, acceptability, and flavor. Savvas et al. [20] observed that yield and fruit quality were negatively affected in the nongrafted and the self-grafted plants under saline stress conditions, increasing the total soluble solids and ascorbic acid content, while grafted plants the yield of two rootstocks was higher and the fruit quality was not affected on any quality characteristics. On the other hand, Martínez-Rodriguez et al. [17] and Di Gioia et al. [6] investigated mechanisms involved in the effects of grafting on yield performance in tomatoes

[7] From the genetic perspective, it has been demonstrated that the difficulties to enrich elite lines with genes from wild species to confer tolerance are linked with the large number of genes involved, most of them with small effect compared to the environment, and high costs of recovering the genetic background of the receptor cultivar [5]. A practical alternative for breeders seems to be the introduction of genes associated with salt tolerance to rootstocks, thereby converting a sensitive cultivar into a tolerant one, maintaining all the highly valuable characteristics which current cultivars possess. New traits are rarely introduced from wild germplasm, requiring many generations to remove the deleterious genes that go along with the introduced genes due to linkage drag.

reporting that the salt tolerance conferred by some graft combinations is related to the ability of the rootstock to reduce the uptake and transport rates of saline ions to the shoot. This salt exclusion mechanism of rootstock might mitigate salt stress [6, 17], which could be a physiological mechanism of salt tolerance in rootstock. Related to the Old Limachino Tomato, we have observed in our hat K^+ extraction in "Old Limachino Tomato" grafted plants were higher than in self-grafted one optimal greenhouse conditions. These antecedents suggest that the use of the salt tolerant rootstock may improve the yield and fruit quality at pre and postharvest under salt stress conditions. Taking into account this hypothesis, INIA is currently starting a research project aimed at revealing mineral regulation (K^+ and Na^+) at the root level using "Old Limachino Tomato" grafting as a model system with emphasis on pre and postharvest fruit quality parameters using a rootstock from an interspecific cross from *S. lycopersicum* and *S. chilense*. So far, our preliminary results suggest that "Old Limachino Tomato" might be characterized as a tomato with a low saline tolerance which reduces strongly its productivity. This, based on compared experiments made with compost with high electrical conductivity and with conventional fertilization management [12].

Since current commercially available rootstocks still exhibit a lack of attributes not allowing the plant to avoid the negative impact of salinity in the Northern and Central zones of Chile, grafting procedure has been recommended as a promising strategy to improve salt tolerance in this local variety. However, the use now of appropriate rootstocks/scion combinations may offer the advantage of combining rustic and vigorous root systems and high-producing shoots, allowing farmers to maximize benefits in non-optimal conditions and to reduce inputs in terms of water and fertilizer. It may thus be hypothesized that a specific selection must be performed to select salt-resistant rootstocks to be used for tomato production in salt-affected areas. In fact, cultivated tomato has numerous wild relatives able to cope with high salinity levels and which could thus be classified as halophyte. Some promising plant species have been therefore exhaustively studied and numerous data are available on *S. pennellii* (Tapia et al. [22], *S. pimpinellifolium* [7], *S. cheesmanii* [2] or *S. galapagense* [18]. For some of these species, interspecific crosses with cultivated *S. lycopersicum* have been successfully performed and hybrids have been characterized [3], although important work is still necessary for the identification of salt-resistant material exhibiting suitable yield capacities. The Chilean halophyte species *S. chilense* surprisingly has received only minor attention from the scientific community. This species is native to the Atacama Desert and is able to grow under salt levels similar to those encountered in sea water. This fascinating ability to manage with a high salt concentration was until now underexploited, mainly because of the allogamous nature of this wild species and the small size of produced fruit, which are undesirable traits to integrate in breeding schemes. Studies carried out by Martinez et al. [15], Tapia et al. [22] and Gharbie et al. [8–10] have shown that wild relative tomato *S. chilense* is tolerant to salinity. For this reason, INIA performed some interspecific crosses between *S. chilense* and the salt-tolerant local cultivar from Northern of Chile. The obtained interspecific crosses exhibited a high relative growth rate and root-to-shoot ratio during preliminary trial. Accordingly, the main hypothesis under revision

is that this material may be used as a salt-tolerant rootstock allowing yield and fruit quality (pre and postharvest) improvements in the salt-sensitive local cultivar ("Old Limanchino Tomato"). Grafting with selected rootstocks issued from interspecific crosses between cultivated *S. lycopersicum* and wild-relative halophyte *S. chilense* has been proposed as an agronomical alternative to improve the salt tolerance of "Old Limachino Tomato".

On the quality side, a few studies on a relatively limited number of rootstocks have been published to report the effect of grafting on tomato fruit quality and its relation to tolerance to saline conditions. According to Savvas et al. [20], using rootstock tolerant to salinity and regulating the ratio of Na^+ to K^+ (lower) can be effective tools to enhance the tolerance of the shoot part and fruit quality. Another report by He et al. [11]) indicates that the alleviation of salinity induced growth inhibition in tomato plants grafted on a Chinese commercial rootstock was related to an enhancement of antioxidant capacity and concomitant improvements in photosynthesis. Preliminary results show that the local rootstock has an effect on the fruit quality (color, taste, aroma and texture) among nongrafted, selft-grafted and grafted plants. The lack of information on the effects of rootstocks on fruit´s quality cultivated under high salinity conditions offers a great room for research.

4 Market, Business Model and Value Chain for the Old Limachino Tomato

4.1 Market and Business Model

As well known, an efficient way to start a particular (and private) business is to insert it within a certain conceptual framework designed for making businesses, making there the necessary adjustments that account for the specific characteristics that the business to raise has and/or requires. In this way, the business of the Old Limachino Tomato proposed at its moment had the first thing that every business and the organization that supports it must have: a logic. In other words, it is necessary to define a Business Plan based on a Business Model. What is sought with the design of a Business Model? Something very simple and complex at the same time: describe the logic of how an organization creates, delivers and captures value in some economic, social, cultural and political context. What is sought with the design of a Business Plan? Define the most important actions that must be performed to create, deliver and capture the said value. In our case, we used the well-known Canvas Business Model (CBM), hereinafter), model based on the work of Osterwalder [19].

In short, the structure of the CBM seeks to identify the logics of interaction between the different parts that make up a business and the organization that supports it. For this, axes (or pillars) and sub-axes are defined. The four axes are: Offer (or Value Proposal), Infrastructure, Customers and Financial Viability. The respective sub-axes are: (a) key partners, key activities and resources; (b) relations with

customers, distribution channels and customer segmentation. Are the axes of the model hierarchically ordered? Yes. The main axis (or main pillar) of the model is the Offer or Value Proposal. In simple and somewhat reductionist words, this axis seeks to clearly define what is being sold or offered to the market. At a higher conceptual level, this axis seeks to clearly identify the sources of business value creation, from the most tangible (relatively easier to quantify monetarily) to the most intangible (those most difficult to quantify monetarily).[8] Because a detailed explanation of all the contents (axes and sub-axes) of the business model for the Old Limachino tomato is beyond the scope of this chapter, we just characterized here -in detail- its main component: the Proposal Value. That said, the sources of value creation identified and associated with the Old Limachino Tomato and its externalities to date are the following:

- Genuine product, unique in the world. Tomato Limachino will be produced under cultivation patterns rooted in the historical-cultural heritage of the producers of the Limache Basin. Currently, its genetic characterization (fingerprint) is being terminated to avoid plagiarism.
- Product with historical heritage. A product with a strong historical story will be offered to the market. Currently, this story is being reconstructed in conjunction with the former farmers of Tomato Limachino in order to restore the ancestral agronomic managements that give the tomato a value of belonging to its territory.
- Product with specific quality. The Old Limachino Tomato is being differentiated from any other tomato through the characterization of its healthy attributes (antioxidant capacity, low sugar content, titratable acidity and carotenoids, among others). To date, statistical data are already available that indicate the superiority of the sensory properties of tomato limachino (flavor, aroma and color) of those related to the most commercial long-lived tomatoes).
- Product with territorial value. It refers to the fact that the cultivation area will be strictly limited to the current Limache Basin, which encompasses the current neighboring communes of Limache and Olmué.
- Product with a better healthy quality. It refers to the innovative improvements in pre and post-harvest under development will increase the current healthy attributes of the fruit.
- Progressively grown product with biological agronomic practices. It refers to the fact that producers are committed to completely and progressively eliminating the use of chemical fertilizers and other non-biological practices.
- Product associated to the recovery of an icon referent of the Limache watershed in the Valparaiso region which generates an intangible asset to be managed jointly by the regional and local authorities to optimize its returns.
- Product with the potential to creating a Gastronomic Route and related undertakings in Limache and Olmué and other communes of the central zone of Chile.

[8] All this knowledge may sound too evident for people who manage medium or large firms. However, every single word of all of this information was completely unknown for the twelve-very-small producers engaged in the project.

INIA and the UTFSM succeeded in transmitting a great deal of this powerful message to the current twelve farmers engaged in the project. In addition, and more importantly, both institutions succeeded in transmitting the message to consumers throughout different channels. Armed with this information, the farmers themselves were able to get, after the bargaining process with one of the biggest Latin-American supermarkets, a selling price never imagined before. More concretely, the selling price set to this intermediary is today about eight times the current selling price of the long-lived tomato varieties that they also cultivate and sell. Therefore, the Financial Viability of the Old Limachino Tomato business is guaranteed and the small farmers engaged in it should focus their attention on other components of the Business plan. One of them is related to logistic aspects of the commercialization which can be tackled by designing properly the value chain for the fruit.

4.2 Value Chain of the Old Limachino Tomato

The value chain of the Old Limachino Tomato for fresh consumption is a simple system and is mainly associated with small-scale agriculture (Fig. 4). The value chain starts from the seed (Box 1: seeds), which considers the use of a genuine genetic material. With this material, the seedlings are produced (Box 2: nursery plant process), sometimes this process is carried out by the producers or the companies producing the seedlings. The waste in this process is mainly associated with: use of seed of poor quality, uncontrolled cultivation and environmental conditions. Box 3 (seedling transport), corresponds to the transportation of seedlings from the company producing seedlings to the farmer. The waste in this step occurs when transport conditions are not adequate. Box 4 (tomato production process + harvest) (Fig. 4) shows the processes associated with tomato production, such as agronomic

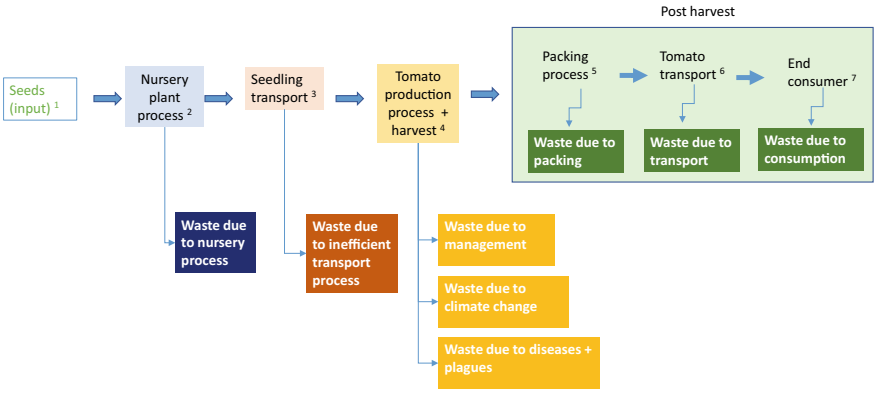

Fig. 4 Simplified schema of the *Old* Limachino Tomato value chain

management and crop conditions. In this phase, the wastes are principally associated with problems in the agronomic management, occurrence of pests and diseases, climate change, among others, including also the losses in the harvest. Box 5 (packing process), wastes are observed when the storage conditions are not adequate, and the fruit shows deterioration in its physiological state, as well as if the selection prior to storage was not appropriate, quality losses are observed (example: store fruit with presence of fungus, produces a spread of the disease in the storage process). The process of the fruit transporting corresponds to Box 6 (tomato transport), use of unsuitable transportation means, which presents wastes that are produced by not using an adequate packaging, uncontrolled environmental conditions of transportation means, and excessive transports. Finally, in Box 7 (end consumer), some wastes occur due to the fruit not consumed and to problems of condition and quality for the consumer [16].

5 Conclusions

Thanks to a joint work between the Agriculture Research Institute (INIA) and the Universidad Federico Santa María (UTFSM), the Tomato Limachino -fruit disappeared of the Chilean tables 45 years ago–is back today. This work involved both technical and commercial efforts. In technical terms, today's renamed *Old* Limachino Tomato (in its French and Italian-types) has been recovered and wholly characterized in its functional, healthy and sensorial capacities. It is known today that it has a higher antioxidant capacity and higher antioxidant content such as polyphenols than the best more commercial tomato varieties. It is also known that it has a rich flavour and aroma that make it appealing to consumers. In commercial terms, it was possible to identify the fruit with a rich historical and cultural heritage associated with the Limache Basin, a place located in the Region of Valparaíso, Chile. Besides, it is known that the fruit fits the current and trendy requirements of healthy quality which significantly increases their willingness to pay. In summary, the business associated with the fruit has an attractive and power Value Proposal that makes, in principle, very sustainable said business. The value chain of this product is being studied in order to optimize the productive process from producer to consumer and reduce wastes. However, there are important challenges to be overcome to guarantee sustainability, particularly for the Peasant Family Farming of the Limache Basin. The weak post-harvest quality of the fruit is one of them. The creation and use of local rootstocks are viewed as a possible solution to this problem. The obtaining of trademarks and certificates of protection are also urgent.

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