

PRODUCTION OF VEGETABLE MEDALLIONS FROM FOOD LOSSES AND WASTE AIMED AT IMPROVING THE FOOD CONDITIONS OF VULNERABLE SECTORS

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Abstract: In the fruit and vegetable belt of La Plata, approximately 42,000 tons of food losses are generated every year, which could improve the nutritional conditions of an important sector of the region's inhabitants. Although the recovery of this food is complex due to a multiplicity of factors, among them, the logistical management of the rescue, and the useful life of the food to be delivered, a substantial factor to consider given the probable loss of properties and nutrients, it has been able to advance in the installation of a vegetable medallion production plant on the property of the La Plata Food Bank. This work demonstrates how, based on the recovery of part of the aforementioned food losses and after a tight analysis of the technical and economic feasibility of its production, it has been possible to install a production plant for 124 soup kitchens. the city of La Plata. The proposed business model has allowed us to provide economic sustainability and the possibility of scaling production.

Keywords: Food Loss and Waste; Circular Economy; Vegetable medallions.

INTRODUCTION

AMBA HORTICULTURAL PRODUCTION

The La Plata fruit and vegetable range is characterized by having intensive production, with small or medium-scale producers (the majority have 1 to 2 hectares), family farms (close to 80% of the producers), informality, and low levels of technology used. The greatest contribution of capital is given by the use of greenhouses. (Varriano et al., 2020)

The greenhouse is the condensation of an agricultural modernization process that includes changes in management, labor, demand and dependence on inputs, among others. (Selis, 2000). Being essential for use today.

At the productive unit level, leafy vegetables

produced under cover predominate in family establishments. As the degree of capitalization of these units increases, fruit vegetables, mainly tomatoes and peppers, are produced, combined with leaf production. Field production, present in percentages that vary between 50 and 25% of the total area of the farms in family production units with a low level of capitalization, is mainly composed of heavy flower, root and leaf vegetables (cabbage), and legumes such as beans (Ferraris & Ferrero, 2018).

The most current data available, regarding the total surface area of the AMBA South belt, is the survey of the surface under cover that was carried out by the INTA (National Institute of Agricultural Technology) through georeferencing. He points out that the surface covered in the districts of La Plata, Berazategui and Florencio Varela would add up to about 7,100 hectares under cover. From the analysis of these preliminary data, it can be observed that about 700 hectares are under floriculture production, 2,500 to 3,000 hectares with diversified leafy vegetables and the rest in tomato, pepper and eggplant crops. (CFI, 2016) (Guerra & Mas, 2017)

At the beginning of 2017, family producer organizations conducted a survey of the number of producers; The total of this registry shows a number of 5,098 producers, of which 4,493 are registered in the RENAF (National Registry of Family Agriculture). To this total of family-type horticulturists must be added the SME (Small and Medium Enterprise) and business producers who, according to unofficial records, do not exceed 15% of the total, which would indicate approximately 750 producers. (Ferraris & Ferrero, 2018)

Vegetable production, according to Central Market sources obtained in 2019, has increased significantly between 2005 and 2019 until reaching a production of approximately 142,000 tons.

FOOD LOSS AND WASTE

Food security is a serious concern in many areas of the developing world. There is no doubt that food production must increase considerably to meet the demands of an increasing and wealthier world population in the future. In developing countries, and sometimes in developed countries, food is lost due to premature harvesting. Poor farmers sometimes harvest crops too early due to food deficiencies or desperate need for cash during the second half of the season. This way, food has lower nutritional and economic value and can be wasted if it is not suitable for consumption. (FAO, 2012).

Food waste is defined as the discarding of food suitable for human consumption or potentially suitable through a transformation or industrialization process. (Rivas, Belgino, Álvarez de Toledo, Franco, 2019).

According to the Food and Agriculture Organization of the United Nations (FAO), globally, between a quarter and a third of the food produced annually for human consumption is lost or wasted. This is equivalent to about 1.3 billion tonnes of food, including 30% of cereals, 40 to 50% of roots, fruits, vegetables and oilseeds, 20% of meat and dairy products and 35% of the fish. The FAO estimates that such food would be enough to feed 2 billion people. It is also estimated that 6% of global food losses occur in Latin America and the Caribbean and each year the region loses and/or wastes around 15% of its available food, despite the fact that 47 million of its inhabitants still live day by day with hunger (FAO, PAHO, WFP and UNICEF, 2019).

In Argentina, 16 million tons of food are lost and wasted annually, of which 1.45 million correspond to losses (production, storage, transportation and processing stages) and 1.5 million to waste (final marketing and household consumption). The food chain that

presents the greatest losses and waste, with respect to its total production, is vegetables: 42.1%. (See Table 1).

Etapas de la cadena	Porcentaje de pérdidas y desperdicios de los alimentos según categorías							
	Carnes	Cereales	Frutas	Hortalizas	Leche	Oleaginosas	Papa	Total
Producción								
Primaria y cosecha	3,71%	4,80%	8,88%	20%	3,50%	6%	14,00%	6,09%
Postcosecha y almacenamiento	1,20%	2,86%	6,61%	8%	3,14%	2,82%	12,04%	3,32%
Procesamiento y envasado	3,19%	0,66%	3,91%	1,75%	1,46%	0,06%	2,18%	0,79%
Distribución	2,05%	0,37%	7,83%	7,16%	2,81%	0,02%	1,96%	1,11%
Consumo	6,89%	0,61%	9,01%	5,21%	3,49%	0,02%	2,22%	1,20%
Total PDA	17,09%	9,29%	29,84%	42,12%	14,40%	8,92%	32,40%	12,91%

Table 1. Percentage of food losses and waste by category

Source: Rivas A. et al 2019 and Varriano N. et al 2020

These vegetables do not reach the market for various reasons; an excess of supply, which means that producers cannot place all their production on the market, or that prices are so low that it is not profitable for them to market it. Another is discarded for not meeting the quality requirements demanded by the market; size, color, maturity, or bumps and general appearance. Despite not meeting market demands, these vegetables are suitable for human consumption. One more factor that adds to this complexity is the logistical management of the rescue.

What was observed corresponds to foods that are not consumed and are discarded at some stage of their life cycle. 28% of losses and waste occur in the first two stages of the chain (Rivas et al, 2019).

Varriano et al, 2020, estimated the availability of raw materials from the fruit and vegetable chain of La Plata, and the merchandise income from the Central Market of Buenos Aires as they are the only ones, reliable and available to date. In Table 2 you can see the data provided discriminated by vegetable variety and origin among other categories. It is assumed that the income corresponding to the province of Buenos Aires corresponds to the production coming from the horticultural cordon of the city of Buenos Aires to which the fruit and vegetable cordon of La Plata belongs (the largest in the province). Taking into account

the participation of the La Plata cordon, they estimated the good production that reached the market from La Plata, the real production (including losses) and the losses of vegetables that did not reach the market.

Tabla 2. Cálculo del desperdicio (materia prima) promedio de la producción del Gran La Plata.

Espece	Producción urban 3 años	Producción Gran La Plata	Producción Total La Plata	Desperdicio (%)
TOBATE	53.750	48.640	102.390	17.962
SECURGA	31.139	32.681	63.820	4.882
JAPALLITO	12.316	10.223	22.539	3.975
PIENITTO	6.485	5.788	12.273	2.255
JAPALLO	16.127	5.645	21.772	2.395
ACEREA	9.211	5.559	14.770	1.560
ESPINACA	5.356	3.227	8.583	1.259
SHOISO	3.757	3.128	6.885	1.253
BERENJENA	3.227	2.762	5.989	1.074
PEPINO	2.851	2.280	5.131	858
REPOLLO	5.640	2.266	7.906	881
BERBERISO	3.015	3.389	6.404	764
PEREJIL	2.058	1.715	3.773	607
BERNARDINA	4.717	3.461	8.178	641
APDO	1.595	1.181	2.776	463
BUCCOLA	2.230	884	3.114	381
NUCULA	1.515	909	2.424	303
PUBERDO	1.400	843	2.243	300
CHACHA	964	797	1.761	202
COUSIDA	2.488	950	3.438	399
TOTAL	303.024	188.013	491.037	42.203

Puerto Esperanza prodg.

Table 2. Calculation of average waste (raw material) of Gran La Plata production

Source: Varriano et al 2020

This way, observing the volume of production of vegetables lost and that do not reach the market (but that are suitable for human consumption), they estimated that the vegetable food needs of almost 300,000 people per year could be covered.

FOOD SITUATION AND FOOD INSECURITY IN AMBA

Severe food insecurity defines situations in which it is declared that some of the members of the household, and in particular the children, experienced “hunger” for economic reasons. While the total deficit threshold, which includes the severe one, is extended to households that had to reduce their food consumption and/or stop eating some of the meals due to economic problems.

The variable that most influences the trajectory of permanence or entry into food insecurity is the condition of poverty and, especially, indigence of the household. The mother’s education is a significant factor in determining the probability of remaining or entering food insecurity: children whose mother has low education are more at risk of experiencing this type of trajectory. (ODSA 2021)

Currently, urban households are characterized by levels of moderate (13.3%) and severe (8.8%) food insecurity, totaling 22.1% of households in situations of food insecurity. This proportion rises to 27.6% in the Buenos Aires suburbs, and is higher among homes with children, reaching up to double. In turn, discriminating between CABA and the Buenos Aires suburbs, a higher incidence is observed among households residing in the latter region, reaching 33% of households with children. (ODSA, 2021)

Tabla 3.1 Incidencia de la Inseguridad alimentaria total y severa en Argentina. En porcentaje de hogares.

	Inseguridad alimentaria total	Inseguridad Alimentaria Moderada	Inseguridad Alimentaria Severa
TOTAL URBANO	22.1%	13.3%	8.8%
Área Metropolitana de Buenos Aires (AMBA)	22.6%	13.6%	9.1%
- CABA	7.6%	3.9%	3.7%
- Conurbano	27.6%	16.7%	11.0%
Resto urbano del país	21.4%	13.1%	8.3%

Table 3. Incidence of total and severe food insecurity in Argentina. In percentage of households

Source: Own elaboration based on ODSA. Agenda for equity (2017-2025). UCA

The combination of two factors such as the existence of losses of foods of high nutritional value and the fact that 22.6% of the population of our region (AMBA) is in a situation of food vulnerability make it necessary to generate actions that tend to reach these foods to the aforementioned vulnerable sectors.

THE SILVER FOOD BANK

The La Plata Food Bank (BALP) is an association that serves 124 cafeterias and picnic areas in the Capital Region on a monthly basis, including some institutions in the Buenos Aires suburbs. The approximate reach is greater than 26,000 people. In 2019, BALP distributed 1,717,031 kg of food dishes. (Alconada M. et al, 2020)

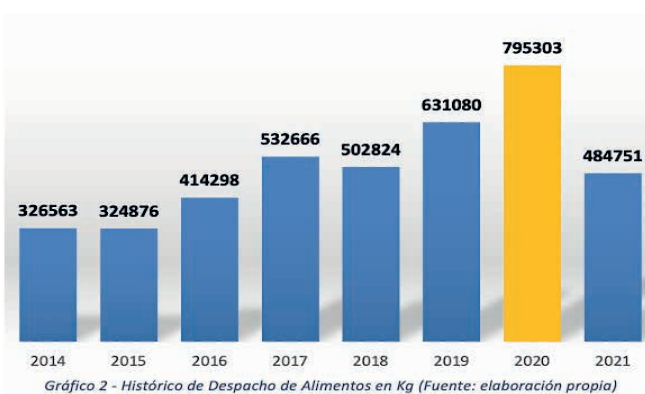
The mission of BALP, as indicated on its website, is “to reduce hunger, malnutrition and poor eating practices in the region, through the recovery of food, to be distributed to community organizations that provide food

services to sectors. needy, developing joint actions with society, based on our values and capabilities.” While its vision is oriented towards finding “a society without hunger, nourished, with socio-environmental awareness, where food suitable for consumption is not wasted.” (La Plata Food Bank, sf).

The BALP has three fundamental functions among the activities it carries out: Food recovery, reception and classification and distribution of food. Added to these activities is the possibility of producing foods of important nutritional value.

The quantity and quality of food received by the BdA fluctuates due to variables in the industry and the market in general, so the management capacity over said volumes of income is relatively low. The year 2020 was a record year as a result of the disconnection between supply and demand caused by the COVID-19 Pandemic. In Graph 1 we can see the historical dispatch values.

From the point of view of product delivery, the aim is to increase the nutritional quality and quantity (kg) delivered by the BdA, with two purposes: to reduce food losses; and contribute to quality nutrition for sectors in moderate and/or severe food vulnerability. A fact worth highlighting is that the merchandise does not remain (in general) stored for more than 3 months, and in no case can it be delivered after its expiration date.



Graph 1: Merchandise Shipments. Source La Plata Food Bank (2022)

After a characterization of the food delivered, it was possible to observe that approximately 69% correspond to “dry products”: non-perishables, snacks, soft drinks, sweets, dressings and refrigerated products, coming from the industry, and 31% are fruits, vegetables or vegetables (Fruver) from the fruit and vegetable range.

The characterization of the products according to their nutritional value shows that 61% of them are high, 21% are medium, and only 15% have a low nutritional level.

PREPARATION OF VEGETABLE MEDALLIONS

The possibility of obtaining a greater rescue of food in the fruit and vegetable belt presents two great difficulties, the logistical management of the rescue, and the useful life of the food to be delivered. In this sense, the possibility of opening new food production and processing units (UP) has made it possible to increase the useful life of Fruver, improve the quality of service to BALP beneficiaries and enable the generation of new lines. of marketable products, which allow financing the operation of the production unit in the long term.

Joint work with the Health Secretariat of the Municipality of Berisso and the Food Bank carried out during 2018 in a sample population of children (average age 6.7 years) from the neighborhoods where the Food Bank has the greatest impact, led to the conclusion that nearly 40% of children are overweight and obese. When we inquire about their dietary conditions, we can see that their daily diet includes large amounts of carbohydrates and low or no percentage of fruits and vegetables.

It is on this reality that the BALP works: trying to change the consumption habits of fruits and vegetables in younger populations, looking for a way to incorporate these mentioned foods into their diet in a sustained

manner over time. Healthy and nutritious nutrition in the first years of children's lives is essential, not only because they are in the stage of growth and formation, but also because it is a determining factor in their state of health and the correct functioning of the body. Furthermore, it is key to the development of optimal learning capacity, communicating, thinking, socializing, adapting to new environments and people, and correct psychomotor development; In short, the prevention of risk factors that influence the appearance of diseases, and that in the future will affect the performance of the adult.

BUSINESS MODEL

Currently, 15% of the installed capacity in the Production Unit of the La Plata Food Bank is being used to produce jams that are marketed as a source of financing for 50% of the operating costs of said unit. This has allowed us to sustain the development of the production of other products such as tomato pulp, sachet jams, vegetable mixes for soups and stews, and in this instance vegetable medallions.

The business model of the production unit used is schematized in the following CANVA diagram (Laguto et al, 2022).

PRODUCTION OF VEGETABLE MEDALLIONS

After an investment of U\$D 16,000 financed by the Bayer Foundation's "Seedbed of the Future" Project, the BALP Production Unit was launched. The entire process had the technical and legal support that the Food Bank has with the La Plata Regional Faculty of the UTN, and the National University of La Plata through the extension project "Application of technologies aimed at ensuring the quality of food" and the collaboration of the "Directorate of food industry and production (DIPA)" dependent on the Ministry of Agrarian

Development of the Province of Buenos Aires.

The Catholic University of La Plata, through its extension groups, made a valuable contribution in the area of Nutrition for the determination of recipes with the best nutritional value and monitoring of anthropometric values of a sample population made up of 5 canteens in the Berisso area.

For the specific production of vegetable medallions, a small plant was set up that has an industrial mixer, a mill to crush cookies and a forming machine with the capacity to make 900 medallions per hour.

Currently, a production batch is made per week of between 1500 and 1800 medallions. All of what is produced is distributed in the canteens that attend the BALP and there is a large unsatisfied demand, so it is expected to gradually increase the volume produced.

The formulation of the medallions has been adjusted depending on the availability of vegetables and there is collaboration with companies that donate resources to purchase raw materials in case they do not have a sufficient flow of donations from the fruit and vegetable chain. In Table 4 you can see the formulation of the vegetable medallions implemented from 2023.

Currently, the Production Unit operates with 2 part-time employees, and the rest of the products delivered by BALP are additionally produced. Making an allocation of 17 hours per week of labor to the production of medallions, we are left with a labor cost of \$24,437.5 per batch and a raw material cost of \$19,750.00. It must be considered that the Knorr company donates in full the ingredient "Sunde mas" (a premix that combines vegetable proteins and spices and serves as a binder, improving the performance of the mixture). Considering the worst scenario, which is the purchase of all the ingredients, the cost per medallion will be \$49 (according to data taken the first week of August 2023).

Key partners FRUVER producers Food Donors (sugar, flour) Partners and donors Pick-up points	Key activities Rescue Production Storage Commercial actions and marketing Social area / nutrition	Value proposal Circular Jam Vegetable mix Pulps Medallions Sachet Jams	Customer relations Social networks Partner mailing Events Magazine WhatsApp Volunteers	CLINET SEGMENT Sponsor segment: customers looking for products with positive impact Beneficiary segment: seeking access to food and improvement in nutritional quality
	Key resources Fruver Donation Production/Logistics Facilities enabled Inputs (Jars, sugar, flour, label)			
Cost structure Supplies Labour Logistics Energy		SOURCES OF INCOME (1) (2) (3) (1) Sale of circular jam (2) Symbolic contribution (3) BDA network contribution (4) Fazon (5) Partner		

Figure 1. Business Model (Laguto et al, 2022)



Figure 2. Images of the Production Plant located in the BALP



Figure 3. Images of vegetable medallions produced at the BALP

Ingredient	Kg/Batch	%
Carrot	30	37%
Corn Grains	10	12%
Green onion	10	12%
Bread crumbs	25	31%
Produce more	6	7%

Table 4. Formulation of vegetable medallions

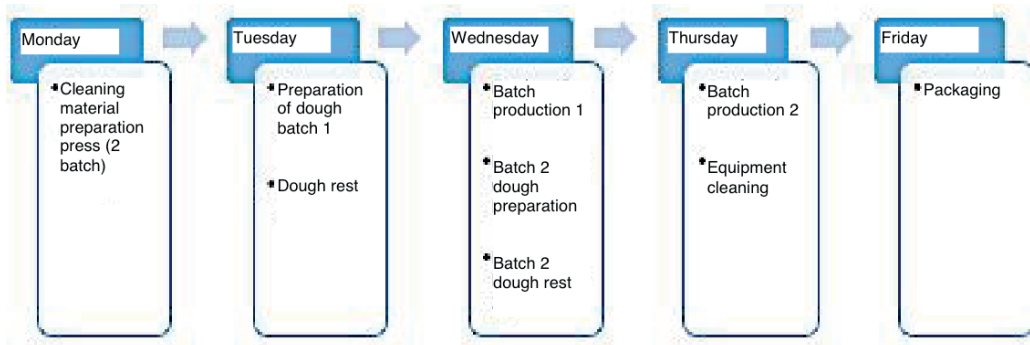


Figure 4. Workflow in the Production plant

The contribution amount paid by the cafeterias is \$90, so there is a profit of \$294,000 per month that is fully used to cover the rest of the indirect costs associated with the activity (freight, energy costs, etc.). In Figure 3 you can see a work flow diagram:

CONCLUSIONS

The launch of a vegetable medallion production unit at the La Plata Food Bank is a technically and economically viable alternative. This unit has made it possible to increase the quantity and quality of food delivered by the BALP, favoring the rescue of food in the fruit and vegetable belt of La Plata.

The Production Unit has reached a level of economic sustainability with the production of jams, to which the production of medallions

has been added, which allows it to strengthen and enhance the capacity of the BALP to fulfill its mission, which is to contribute to the reduction of the food vulnerability conditions of the population.

This way, the University relates to the environment by providing technical knowledge, qualified volunteer labor and promoting service learning activities, constituting a good practice of university social responsibility.

THANKS

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REFERENCES

- Varriano, Nicolas, Sebastian Laguto, Pablo Giovannone, Nicolas Andriolo, y Tomas Martinez Perea. 2020. «Análisis de pérdidas y desperdicios de hortalizas en el Gran La Plata. Su potencial uso como materia prima en la producción de alimentos.» Ingenio Tecnológico.
- Selis, D. (2000). **Efectos del cambio tecnológico sobre las condiciones de producción y reproducción del sector hortícola de La Plata.** Serie de Estudios e Investigaciones, 39, 31–56. Recuperado de: <http://www.memoria.fahc.e.unlp.edu.ar/libros/pm.182/pm.182.pdf>
- Ferraris, G.; Ferrero, G. (2018). **Análisis de la estructura agraria en los sistemas hortícolas del AMBA-SUR.** Facultad de Ciencias Agrarias y Forestales, 117
- CFI. (2016). **Informe Sectorial Hortícola Argentino. Consejo Federal de Inversiones.** Recuperado de: <http://bibliote.ca.cfi.org.ar/wp-content/uploads/sites/2/2016/07/informe-horticola.pdf>
- Guerra, F. G.; Más, D. A. (2017). **INTA AMBA relevó importantes pérdidas luego de la última tormenta.** Recuperado de: <https://inta.gov.ar/noticias/inta-amba-relevoimportantes-perdidas-luego-de-la-ultima-tormenta>
- FAO. 2012. **Pérdidas y desperdicio de alimentos en el mundo – Alcance, causas y prevención.** Roma: Organización de las Naciones Unidas para la Alimentación y la Agricultura. Recuperado de: <https://www.fao.org/3/i2697s/i2697s.pdf>
- Rivas, Alejandro; Blengino, C.; Álvarez de Toledo, B.; Franco, D. (2019). **Pérdidas y Desperdicio Alimentario (PDA) en Argentina.** Ministerio de Agricultura, Ganadería y Pesca. Argentina
- FAO, OPS, WFP y UNICEF. (2019). **Panorama de la seguridad alimentaria y nutricional en América Latina y Caribe.** ISBN 978-92-5-131958-1. Recuperado de: <http://www.fao.org/3/ca6979es/ca6979es.pdf>
- FAO. 2019. **El estado mundial de la agricultura y la alimentación.** Progresos en la lucha contra la pérdida y el desperdicio de alimentos. Roma: Organización de las Naciones Unidas para la Alimentación y la Agricultura.

ODSA. (2021). **Riesgos Alimentarios Y Prácticas De Consumo En La Argentina Urbana**. Buenos Aires: Observatorio De La Deuda Social Argentina.

Alconada, Manuela, Carla Maroscia, Adriana Fassio, Maria Gabriela Ruty, Liliana Galan, y Maria Laura Zaidman. 2020. «**Emergencia Alimentaria Y Aprendizaje En Gestión De Los Comedores Que Articulan Con El Banco Alimentario De La Plata.**» ADENAG 41-53.

Banco Alimentario La Plata (s.f.). **¿Quiénes somos?** Recuperado de: <http://bancoalimentario.org.ar/quienes-somos/>

Laguto, Sebastián, Varriano Nicolás, Giovannone Pablo (2022). “**Análisis De Viabilidad Económica Del Procesamiento De Pérdidas Y Desperdicios De Alimentos Destinadas A Mejorar Las Condiciones Alimentarias De Sectores Vulnerables De La Ciudad De La Plata**”. COINI 2022