

Hydroponic lettuce production and minimally processed lettuce

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Abstract: People's concern about their health and well-being is increasing. As a result, the greenery appears as an important food and agricultural areas need to be efficiently used. In this context, there are concerns about the environment, which is another important factor, as it has to ensure sustainability. It was due to these demands the use of hydroponics which appears as an alternative to be implemented for soil conservation and preservation of water resources. The objective of this work was to project a system for producing hydroponic lettuce and analyses its technical and economic feasibility, aiming to supply snack bars of Pelotas, RS, Brazil, with a minimally processed product (washed and cut lettuce). A study of the snack bars market was conducted. The snack bars were classified as small, medium, and large. From these data, the equipment was chosen to achieve the necessary unit operations to produce hydroponic lettuce and lettuce minimally processed. The mass balance studies and layout were also done. The study of economical indexes to establish the viability or otherwise of the project was done. These indexes were: NPV (Net Present Value), IRR (Internal Rate of Return) and payback. The analysis was performed in a planning of 10 years and considering a MRA (Minimum Rate Attractiveness) of 11.6% per year. Three scenarios for the project were studied. Scenario 1: a greenhouse with a maximum capacity of 59,400 heads of lettuce per year, predicting a time of learning to achieve maximum production in the seventh month. Scenario 2: two greenhouses, considering to be sold 70% of production in the first year, 85% in the second year and all production only in the third year. Scenario 3: three greenhouses, considering that all production will be sold only in the fourth year.

Technically, the project proved to be feasible by allowing producing large amount of lettuce in a small area, in a minimally processed hydroponic system, generating a practical and sanitary product. Because the greenhouse is a relatively large investment, and the compaction of the countertops, decreased the necessary inner space, allowing eliminating wasted space in the production area. The project proved to be unfeasible with only one greenhouse, but two or three greenhouses showed to be feasible. However, when deployed, the project with two greenhouses in the first year, and three greenhouses in the first two years, will need an investment of capital to withstand the years without profitability.

Keywords: marketing, leaf vegetable, packaging

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1 Introduction

People's concern about their health and well-being is increasing. As a result, the greenery appears as an important food. Moreover, population growth is increasing rapidly and consequently there is an increase in food consumption, but the areas for agricultural crops

do not increase at the same rate. The agricultural areas need to be efficiently used. In this context, there are concerns about the environment, which is another important factor, as it has to ensure sustainability. It was due to these demands the use of hydroponics which appears as an alternative to be implemented for soil conservation and preservation of water resources.

According to Resh (1997), hydroponics is an alternative technique in which the soil is replaced by an aqueous solution containing only mineral elements

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required to vegetables. Furlani (1998) said that plants grow in cultivation channels through which nutrient solution circulates intermittently at defined intervals and controlled by a timer, by their own profiles for the hydroponic cultivation system.

Lettuce (*Lactuca sativa* L.) is the vegetable used in larger scale in hydroponics, called NFT (Nutrient Film Technique) or technique of laminar flow of nutrients. This is in agreement with Ohse et al. (2001), that comment hydroponics is easy adaptation system, which has shown high performance and reductions in cycle compared to growing in soil.

In 2012, it was produced of lettuce and chicory more than 24,946Mton and 223,487Hg/ha of yield in the world. The production share were 57.1% Asia, 24% Americas, 16.8% Europe, 1.3% Africa and 0.9% Oceania. Main producers were China, USA, Spain and Italy. Main countries delivering were Belgium-Luxembourg, Kuwait, Congo, Austria and USA (FAOSTAT, 2014).

In USA, a small number of firms are responsible for growing, processing and transporting lettuce to retail outlets. Today, almost all head lettuce is field packed for bulk sale or for transporting to a salad processing plant. Estimates suggest that about one fourth of all iceberg lettuce is now destined for processing into packaged salads (ERS 2006)

Lettuce is the leaf vegetable most consumed in Brazil, and is considered the basis for salads. According to Cenci (2011) and ERS (2006), it is practicality because lettuce demands minimal processing operations. Basically, it is necessary to subject the vegetable to a few physical changes, such as washing and cutting greenery, making it ready for consumption or preparation.

The industry of fresh-cut fruits and vegetables is constantly growing due to consumers demand. Techniques for maintaining quality and inhibiting undesired microbial growth are demanded in all the steps of the production and distribution chain (ALLENDE; TOMÁS-BARBERÁ; GIL, 2006).

The objective of this work was to project a system for producing hydroponic lettuce and analyze its technical and economic feasibility, aiming to supply snack bars of Pelotas, with a minimally processed product (washed and cut lettuce).

2 Material and methods

The production system of hydroponic lettuce and minimal processing are projected to be in an area of 11x284m, 1.600m from downtown Pelotas, leading by a couple and an employee.

A study of the snack bars market was conducted in Fragata subdivision of Pelotas/RS, due to the proximity of the production place. The snack bars were classified as small, medium, and large, because there is great variation in consumption among them.

An analysis of competitor was also conducted to assess the risks of the enterprise.

From these data, the equipment was chosen to achieve the necessary unit operations to produce hydroponic lettuce and lettuce minimally processed. The mass balance studies and layout were also done.

The study of economical indexes to establish the viability or otherwise of the project was done. These indexes were: NPV (Net Present Value), IRR (Internal Rate of Return) and payback, according to Buarque (1991) and Casarotto (2009). The analysis was performed in a planning of 10 years and considering a MRA (Minimum Rate Attractiveness) of 11.6% per year.

Three scenarios for the project were studied. Scenario 1: a greenhouse with a maximum capacity of 59,400 heads of lettuce per year, predicting a time of learning to achieve maximum production in the seventh month. Scenario 2: two greenhouses, considering to be sold 70% of production in the first year, 85% in the second year and all production only in the third year. Scenario 3: three greenhouses, considering that all production will be sold only in the fourth year.

3 Results and discussion

By studying the market it was established that the weekly demand of lettuce of snack bars in Fragata subdivision was 1,290 heads of lettuce to supply. Thus, it was found that there are six small snack bars, ten medium, and seven large bars, with an average consumption of 15, 50 and 100 heads of lettuce per week, respectively. Whereas losses are around 30%, a production of 1,500 heads of lettuce per week is required. The portion of the production not sold in snack bars will be marketed as hydroponic product packaged for retail.

The study determined that the greenhouses will be built in wood, the *pampeana* type, with 8x70 meters. From the data obtained, the flowchart/mass balance from production to marketing seedlings of lettuce was made (Figure 1).

To optimize the inner space in the greenhouse, a system of trails that allow the benches to slide and be compacted, opening the corridors for people who will transplant or harvest lettuce, was designed.

The production of seedlings was divided into two stages: 1) production of seedlings I, held in phenolic foam lasting around seven to 10 days, comprising between

sowing or cutting up the first pair of leaves; 2) seedling production II, when the seedlings are transplanted to hydroponic profiles, including between the first pair of leaves until the fifth leaf. After this point, the lettuce enters the final stage of growth, around four weeks, when the plants will be harvested.

Subsequently, harvesting and washing lettuce occurs. The processing will be made in two ways: Model 1: lettuce will be packed for delivery in big boxes to the snack bars; Model 2: lettuce will be harvested, packed and shipped to the market.

The main competitors of this project are the markets of the region. They supply the stores with lettuce today. Other competitor is the rural producer, who offers the same service. Other competitors are the local market and retailers in the northern region of the city. However, as the demand is low and the product cannot be stored, it makes buying lettuce too costly in these establishments. The purchase prices of the head of lettuce in the snack bars were averaged: in the regional market US\$ 0.45; directly from the farmer US\$ 0.22; in the local market and retailers US\$ 0.34.

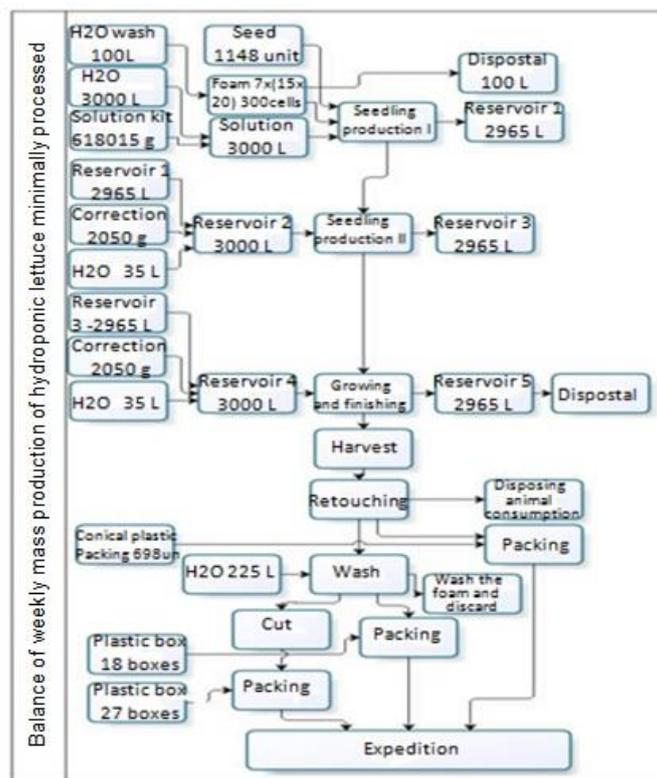


Figure 1 Flowchart and mass balance from production of marketing hydroponic lettuce

This market needs regularity both in delivery and in quality. For this, contracts will be signed to ensure buyers of a regular supply of the product. If there is any problem with the production, to ensure delivery, lettuces will be purchased from another region to meet the demand.

Budgets and revenue forecasting can assemble cash flow and the economical indexes were analyzed, as shown in Table 1.

Table 1 Economical indexes of the scenarios studied

Index	Scenario 1	Scenario 2	Scenario 3
NPV, R\$	-76,893.29	34,746.52	55,814.46
IRR, %	-	24,25	24,48
Payback, years	-	5	5

Scenario 1 proved to be unfeasible. Scenario 2 showed loss in the first year and then the amount invested begins to return, already having an IRR of around twice the MRA, which was considered 11.6%. Scenario 3 is very similar to Scenario 2, but this scenario has financial loss over the first two years, meaning the company would have to have capital to support two years without profits, but after this period has no return on investment from the fifth year.

4 Conclusions

Technically, the project proved to be feasible by allowing producing large amount of lettuce in a small area, in a minimally processed hydroponic system, generating a practical and sanitary product.

Because the greenhouse is a relatively large investment, the compaction of the countertops, decreased the necessary inner space, allowing eliminating wasted space in the production area.

The project proved to be unfeasible with only one greenhouse, but two or three greenhouses showed to be feasible. However, when deployed, the project with two greenhouses in the first year, and three greenhouses in the first two years, will need an investment of capital to withstand the years without profitability.

It is recommended to study whether the project would become more attractive with the production of other crops such as tomato, zucchini, among other hydroponics.

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