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TECHNICAL STUDY OF THE INSTALLATION OF A WATERCRESS NECTAR PROCESSOR TO REDUCE ANEMIA IN ADULTS

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Abstract:
Peru has a diversity of exotic fruits and plants with recognized yields for food and health protection. Nectars are highly consumed food products, made from fruits or vegetables. The objective for the present work was to carry out the technical study of the installation of a watercress nectar processor to reduce anemia in adults; identify the demand, technical requirements for the operation and profitability of the processing facilities. Methodology. The analytical-synthetic method was used; The population of the target market was analyzed, the size of the sample was determined with the coefficient of variation method, (n = 384), the instrument used was the survey; the technical, economic-financial study was carried out. The results were the growth in the demand for nectars of 59.82%, with respect to the economic-financial evaluation, it has been shown that the results are satisfactory for the installation of the plant, with the economic and financial IRR, both rates proving to be attractive. for the project. From the projected income statement for the 2021-2025 period, it can be deduced that for 2025 there was a net profit of S/316,971.39. Other indicators such as the economic and financial NPV, the B/C ratio and the PRI that were satisfactory for the Project, making its execution viable. The conclusion this study was the technical study for the installation of a nectar processing plant to reduce anemia in adults in Lima, which was viable in terms of operation and profitability, taking advantage of its healing and nutritional properties.

Key words: *Anemia, operations research, productivity, profitability, watercress*

INTRODUCTION

Nutritional deficiency is very common in the world, the World Health Organization in 2017 estimated that more than 2 billion human beings suffer from anemia, approximately 1200 million are adults and the difference is under 5 years of age, its incidence remains constant: 58.1% (2011) and 58.3% (2018). In Latin America, 22.0% of the population has anemia and in Peru, 32.0% has anemia, a value well above the average [1].

Tarqui-Mamani et al. [2] stated that anemia in the elderly increases as time progresses and is linked to their lifestyles. It is important to mention that the Peruvian Journal of Experimental Medicine and Public Health (2017) indicated that low doses of iron in the diet of elderly people cause a low level of red blood cells, ulcers, polyps. Anemia as a chronic disease is related to kidney and heart failure, and other chronic diseases: the bone marrow does not efficiently produce red blood cells and unexplained anemia: reduction in hemoglobin levels.

In Peru and in the world, the adult population over 60 years of age has grown vertiginously, due to a reduction in the birth rate and mortality that results in the aging of the population. Instituto Nacional de Estadística e Informática [3], indicated that adults over 60 years of age have increased from 800,000 in 1972 to 2,500,000 people in 2007, reaching 3,496,444, representing 11.9% of the total population, being 70% with urban residence and within it 37% in Metropolitan Lima. In this regard [4]; He mentioned that anemia in the elderly is not caused by his age, so he requests that doctors be more exhaustive when caring for their patients, considering their antecedents and clinical reports. The author adds that one of four elderly people in Peru has had anemia, which causes their cognitive ability to diminish and increases mortality from cardiovascular events; therefore, anemia in adults can be a warning of a much more serious disease, such as cancer.

According to the [5] published that "in recent years it has been observed that adults and elderly people neglect their health and well-being in the background (8.3% of per

capita spending in 2019), and prioritize other expenses, such as essential meals and service charges; He also indicated that there is no evidence of this public to change, for healthy foods, because they are not familiar, making it difficult for them to accept them and in turn, there is a certain fear regarding the price of these products; Due to the fact that the current market has not shown interest in consuming food, which is beneficial for the elderly. This market is more oriented to offering innovative products with a low amount of nutrients, beyond offering them as finished products that have a high percentage of natural inputs and are from fruits or plants [6].

In our environment, it is not appreciated that there is a tendency for the elderly to consume healthy, natural and nutritious products, because they are not familiar with it, which makes it difficult to accept them; in addition, the lack of interest in offering them and thus promoting the demand for them, so that the age group has quality of life. Likewise, at present, the nectar juices that are found in the Peruvian market are mainly fruits and in fewer plants, ignoring the importance they have for their health benefits and above all, for the adult population; moreover, in this time of pandemic with the emergence of COVID-19, which has drastically modified the attitude and thinking of older adults; emerging interest in them to prevent and take care of diseases that may affect their health [7].

In metropolitan Lima, the prevalence of anemia in older adults, during the last five years was 54.3% and did not show a relationship with socioeconomic level, even though many of them have the Comprehensive Health Insurance (SIS) they are resistant to sulfate treatments [8].

W. Zafra [9], concluded that the viability of the elaboration and marketing of fruit nectars with pieces of aloe vera, improves health and living conditions in the applicants of natural beverages, the ordering test was used according to acceptability, taste, color and consistency. Determined and analyzed the environmental factors, showing a good business opportunity in Metropolitan Lima, and the sale of vigorous and beneficial nectars based on aloe vera, according to the [5], the increase in the number of natural product establishments in Metropolitan Lima has also achieved an increase in the GDP of the manufacturing industry, with 11.8%, in the last five years, together with the laws that protect, protect and promote the processing, marketing and consumption of healthy beverages, It fosters a suitable and advantageous environment, increasing the volume of bidders and demanders, so these laws will favor the smooth running of the project.

The research formulated the following general problem: does the technical study of the installation of a watercress nectar processing plant reduce anemia in adults in Lima? And as specific problems: what is the demand for a watercress nectar processing plant to reduce anemia in adults in Lima? What is the technical requirement for the operation of a watercress nectar processing plant to prevent anemia in older adults in Lima? What is the profitability of operating a watercress nectar processing plant to reduce anemia in older adults in Lima?

The present study has as limitations the installation of the watercress processing plant to reduce anemia in adults due to budgetary issues of the authors, however, the present investigation has covered all the necessary elements so that it can carry out the implementation, demonstrating its viability of installation. and low cost.

LITERATURE REVIEW

Cárdenas-Quintana & Roldan-Arbieto [8], determined the incidence of anemia in older adults in Metropolitan Lina, used a sample of 300 older adults from different economic strata, finding that 30.5% of men and 23.8% of women had anemia, showing no relationship with the stratum socioeconomic.

In an investigation [2], to define the incidence of anemia and linked agents in older adults, used probabilistic, stratified and multistage sampling in 5,792 homes in the departments of Peru, and concluded that approximately 25% of adult's older people have anemia.

Padilla (2013), indicated that he evaluated the nutraceutical capacity of cookies prepared with watercress, concluded that it contains an additional 30% of proteins and fibers, compared to control cookies. Inductive deductive method was used from opinions of the curative characteristics of watercress; he worked with analytical method and experimental method. The nutraceutical value was 8.1464 mg of vitamin C contribution, and that the iron contribution is 21.98 mg, being 6.8% higher than in the control biscuit.

Casanovas [10], measured the daily needs of the amounts of nutrients in uncooked foods, in a rigorous study for the Center for Preventive Chronic Diseases, calculated the percentages in raw foods according to daily needs, found that watercress led the relationship with a 100% final percentage, surpassing the second place by 8%, becoming the ideal food to reduce the risk of chronic diseases.

Cabascango [11], in his research, determined the existence of microorganisms and heavy metals in watercress, since there is no research on the safety of watercress in the different outlets of the capital of Ecuador, Quito, its presence in the menu being very important of the Ecuadorian food; in order to investigate the safety of its consumption and eliminate the risk to health. The samples were evaluated according to their color, odor, size and weight of leaves, and the physicochemical characterization, calculating the humidity, Brix, pH. Lead and cadmium were in the maximum concentration category in vegetables, and the Colony Forming Units per gram of mesophilic aerobes exceeded the established microbiological limits, it is concluded that the watercress sold in the Quito markets are unhealthy with a health risk

Mamani [12], in his research demonstrated the benefit of an apple drink with quinoa, used economic-financial indicators and the survey technique, aimed at people residing in Metropolitan Lima and concluded that the market favors the presence of the project, at a level Optimum, visualized in the applied instruments, considered an investment of 4,835,103.96 soles, with 59.1% of financed capital

yielded positive values for financial economic factors: (VANE = 6,354,769.71 and VANF = 7,937,492.00); (T.I.R.E = 112% and T.I.R.F. = 215%) [6] in their research developed in the province of Arequipa, aimed to determine the profitability and the IRR in a company that sells nectar for anemia, applied the survey technique to a sample of 400 people, interviews were conducted To experts, the project showed satisfactory economic indicators: net profit of S/618,038 in the first year of its installation, a payback period of 5.71 years, and the capital would be recovered in 4.94 years.

As a limitation, there was social isolation due to the pandemic caused by COVID-19, in the compilation of the data an online questionnaire was used to the established sample of older adults.

Plant distribution is a process of organizing the precise areas for machines, raw materials, movement, stockpiling of finished items, labor and complementary areas to establish a production process for the achievement of established ideally with workable efficiency. The importance lies in achieving the optimal operation of the facilities. It is used when the ordering of machines and equipment is necessary in a defined area [13].

The general objective of the installation of plants is to achieve a better arrangement of work areas, equipment, raw materials, with the aim of being practical, economical, aesthetic, safe and pleasant for human resources. In addition to reducing costs and cadence, improving safety and product quality, increasing flexibility, minimizing material handling, improving space utilization, improving maintenance, reducing delays, greater and better utilization of machinery and hand of work, determine the congestion areas [13].

The nature of plant distribution problems can be presented in different ways (see Figure 1), for an optimal layout, consider the principles: of overall integration, of the minimum distance traveled, of circulation, of cubic space, of satisfaction and safety, and of flexibility.

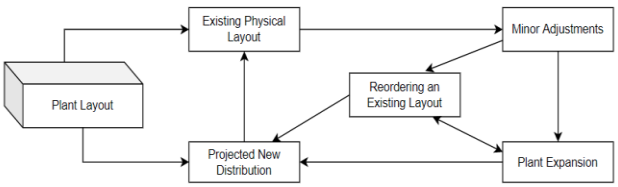

Fig. 1 Nature of Plant Distribution

A good distribution must consider all the factors¸ that is, a systematic process to obtain maximum benefits, there are some factors that affect the distribution of the Plant such as: materials, machinery, human resources, movement, waiting time, service, building, change, among others.

The classic types of distribution or plant layout are by fixed position (the material remains fixed, operators, machines, tools and other components converge to it), by process (the product moves from one department to another) and arrangement by product (best suited to mass production industries), see Table 1.

Table 1
Nectar demand in millions of liters

Year	Project demand [Millions of Liters]
Year 1	11863
Year 2	21142
Year 3	33352
Year 4	48835
Year 5	67883

The organization of the layout comprises four phases: location of the areas to be distributed, general distribution or macro distribution, detailed distribution or micro distribution, and installation.

Watercress (Nasturtium officinale) is a very nutritious legume, as it contains vitamins B1, B2, B6, C and E, carotenes and manganese, fiber, iron, copper and calcium. By having abundant content of calcium and phosphorus, it is associated with benefits against osteoporosis. The price in the domestic market is around US $ 3.00, while in the United States market, with a value of US $ 7.00. Production is seasonal and transitory. In times of pandemic, it is necessary to diversify to new forms of presentation, at competitive prices where the consumption of healthy products with a high percentage of nutrients is prioritized. It has around 15 mg of vitamin C per cup (34 grams), when consumed, it turns it into a natural antioxidant that helps increase resistance and slow the evolution of aging [14]. Its cultivation is permanent, it has bright green leaves and small white flowers, it has a harsh taste and a pungent smell, the leaves and stems are used for human consumption. It is considered a vegetable with tender leaves and stems [15].

Watercress is not affected by environmental conditions and can be grown throughout the year, as long as there is sufficient availability of water and humidity, watercress is used as food, although it can also be included as a very beneficial medicinal plant for the body, Due to its antiviral, bactericidal, expectorant and tonic properties, it occurs in higher production in the months of April to June [16]. The nutritional content in fresh watercress can be seen in Table 2.

Table 2
Nutritional value of 100 g of fresh raw watercress as a percentage of the daily requirement for an adult

Element	Amount	Percentage of daily required
Energy	11 kcal	< 1.0%
Protein	2.30 g	4.0%
Total fat	0.10 g	0.5%
Dietary fiber	0.5 g	1.0%
Pantothenic acid	0.31 mg	6.0%
Pyridoxine	0.129 mg	10%
Vitamin A	3191 IU	106%
Vitamin C	43 mg	72%
Vitamin E	1 mg	7%
Vitamin K	250 mg	208%
Calcium	120 mg	12%
Copper	0.077 mg	8.5%
Manganese	0.244 mg	11%
Match	60 mg	8.0%
B-carotene	1914 mcg	---
Lutein – zeaxanthin	5767 mcg	---

Watercress nectar takes advantage of the concentration of nutrients, its leaves are 94% water, becoming natural and medicinal food: it prevents anemia, regulates obstruction, reduces swelling, prevents liver malfunction, controls diabetes, among others [17]. Anemia generates exhaustion, increases the heartbeat, cadaverous skin; The magnitude of these symptoms depends on the Hb level, in most cases anemia is established slowly, producing few symptoms because the body adjusts to tolerate quite low levels of Hb, when the other organs (lung, heart, etc.) function correctly [18].

A state in which hemoglobin levels are lower than normal, that is, the concentration in the blood is < 12 g/dl in women and < 13 g/dl in men, in addition, a gradual decrease of 2 g/dl more than the normal concentration of the patient, although it remains within the normal limits for their age and sex [19].

The objective of our research work was to carry out the technical study of the installation of a watercress nectar processor to reduce anemia in adults; We also identified the demand for watercress nectar, technical requirements for the operation and profitability of the watercress nectar processing facility to reduce anemia in adults in Lima.

METHODOLOGY OF RESEARCH

The research is non-experimental, "existing circumstances are observed, occurred randomly, of a transactional type in order to specify variables, study the occurrence and their correspondence, in a given time" [20].

The research presented a quantitative approach, since according to [21], its analysis is based on observable and measurable aspects through statistical tests. The author adds that it is based on collecting data to answer the research problem, using statistical tools to distinguish the value of the assumption.

The research carried out was descriptive – explanatory, descriptive: when seeking to recognize how people classified as potential consumers in an objective and explanatory market perceive, they try to explain why they occur or why the variables are related [20].

The analytical-synthetic method was used; According to [22] it begins with the decomposition of the object of study to examine them individually and then they are incorporated to examine them holistically and comprehensively. The total population of Metropolitan Lima and the population by five-year age range were analyzed.

According to the INEI, there are more than one million older adults over 60 years of age in Metropolitan Lima, the districts with the largest number of this population are in the districts of: Downtown Lima: San Isidro, Jesús María, Pueblo Libre and La Punta of the constitutional province of Callao [5].

Therefore, it was decided that the population of the present investigation will be made up of both adults and adults over 45 years of age in Metropolitan Lima from the following districts: Jesús María, Lince, Pueblo Libre, Magdalena, San Miguel, Miraflores, San Isidro (Zone 6). San Borja, Surco and La Molina (Zone 7). Next, the number of inhabitants of the districts of zones 6 and 7 of Metropolitan Lima is shown, where the number of the total population is 1'344,489 inhabitants, of which 273,930 are people over 45 years of age and are in the indicated areas, for which, according to [23], indicated that when the population is greater than 100,000 people, the Coefficient of Variation method is used to determine the sample size, with the population universe being 273,930 to be studied, the sample size was determined with a confidence level of 95% and a statistical precision of 5%, using the following formula:

$$n = \frac{CV^2 \cdot Z^2}{E^2}$$

Replacing the values:

CV = 0.25,

Z = 1.96,

E = 0.05.

Being:

CV – Coefficient of variation,

E – Statistical precision,

Z – Standardized value of the normal distribution.

$$n = \frac{0.25^2 \cdot 1.96^2}{0.05^2} = 384$$

The unit of analysis corresponded to adults over 45 years of age, as they were the most likely to suffer from anemia, affecting the immune system, generated by a diet low in nutrients, due to ignorance and the little nutritional value they have about consumption of natural foods.

For [24], the research technique “is the form of execution used by the researcher, in order to collect data and reference information. The present investigation used the survey technique” (p. 155). According to Rosendo [25], in market research the survey technique is applied, from which enough information is obtained to identify and quantify the target market segment (p. 35).

The data collection instrument is a resource that allows the researcher to approach the units of analysis and extract the data and pertinent information, they must be reliable and valid to guarantee the results and conclusions obtained [24].

The present research used a questionnaire instrument, framed in a web application (browser), of the Google forms (form), in whose content the indications, questions and alternative answers to be completed by the respondents were presented.

The data collection allowed to know the opinions, characteristics and trend towards the consumption of watercress nectar, aimed at people from the study areas, socioeconomic level A, B and C and age range over 45 years, regardless of sex; Descriptive statistics were used to process the information. The technical study evaluated whether the project is technically, economically and operationally viable, determined the value of the investment and the profitability of the project, evaluated the combination of resources that allow the effective preparation of the product [26]. The market study was fundamental in the design of the project because it determined the level of demand for a new product [27].

The reliability of the instruments, according to [28] is the degree of similarity of the responses verified between the researcher and the researched. It was carried out through

a pre-test applied to 30 older adults, using the KR20 whose result was 0.842, dichotomous, which corresponds to a high level of certainty for the research test, and processed in the Excel statistical software; This technique was used because the reagents of the evaluation instrument are dichotomous, in the same way, a 12-item operational research test was used.

In the same way, the content validity was carried out, which according to [29], refers to the competence of a tool to calculate in a revealing and adequate way, the quality of whose measurement it was designed. It was carried out through the opinion of judges or experts in relation to the research instrument, considering criteria of clarity, relevance and coherence. The population by zones in the target market was determined (see Table 3).

Table 3
Population by Target Zones of Metropolitan Lima

Year	F = People from socioeconomic level A, B, C in zone 6 of Lima	G = People from socioeconomic level A, B, C in zone 7 of Lima	H = People from socioeconomic level A, B, C in zone 6 & 7 of Lima
2013	333 397	690 134	1 023 531
2014	357 127	715 778	1 072 905
2015	352 935	708 185	1 061 120
2016	372 616	731 921	1 110 453
2017	382 385	740 947	1 123 332
2018	393 732	752 724	1 146 456
2019	405 078	764 501	1 169 579

The historical demand for nectar consumption obtained according to [5] publications, for the identified areas of the potential market under study (see Table 4).

Table 4
Total Historical Demand for nectar consumption, in the Potential Market Zones

Year	L = People who consume nectar in Lima of socioeconomic level A, B and C in zones 6 and 7	M = Annual per capita consumption of nectar in Peru (liters/person)	N = Historical demand (liters)
2013	660 996	11.82	7 812 972,72
2014	666 596	11.94	7 959 156,24
2015	748 938	12.06	9 032 192,28
2016	792 653	12.18	9 654 513,53
2017	839 803	12.30	10 329 536,90
2018	891 484	12.42	11 072 231,28
2019	944 552	12.54	11 844 682,08

The projected demand was determined, analyzing the values obtained in Table 5, from which the linear, exponential, logarithmic, polynomial and potential regression models were developed, where the coefficient of R2 closest to unity is polynomial regression. The projected demand for nectars consumption in Metropolitan Lima is shown in Table 5.

Table 5
Projected demand for nectar consumption for Metropolitan Lima

Year	Million liters
Year 1	12,71
Year 2	13,57
Year 3	14,48
Year 4	15,43
Year 5	16,41

The unsatisfied demand was calculated based on the projected historical demand and supply, Table 6.

Table 6
Unsatisfied demand for nectar for the Project

Year	Projected demand (A)	Projected offer (B)	Unsatisfied demand (C = A-B)
1	12 701 271	12 095 700	605 571
2	13 571 750	12 646 900	924 850
3	14 479 965	13 203 100	1 276 865
4	15 425 915	13 764 300	1 661 615
5	16 409 604	14 330 500	2 079 104

The demand for the project was calculated based on 65.3% of the unsatisfied demand, by 3.0% of this demand, resulting in 1.959%, for the first year of operation. Then it was proposed that each following year, it will increase by 0.5%, such results are displayed in Table 7.

Table 7
Nectar consumption demand for the Project

Year	Projected demand (A)	Projected offer (B)	Unsatisfied demand (C = A-B)	% Unsatisfied demand	Project demand
1	12 701 271	12 095 700	605 571	1.959	11 863
2	13 571 750	12 646 900	924 850	2.286	21 142
3	14 479 965	13 203 100	1 276 865	2.612	33 352
4	15 425 915	13 764 300	1 661 615	2.939	48 835
5	16 409 604	14 330 500	2 079 104	2.265	67 883

The size of the plant decides the value of the investment, the production capacity allows to quantify the operating costs, the income, the quantity demanded, the inventories, the location of the plant, the cost of the equipment and other related. Three types are identified: design capacity, system capacity, and actual capacity. To evaluate the size of the plant, the predetermined times and displacements of the process are needed [30].

The demand conditions the size of the plant, and it is accepted when it is larger; otherwise, it would imply risk. The inputs and supplies must exist in sufficient quantity and quality. Technology is a decisive factor in investments and production costs, helping to reduce it and increase profits. The investment capacity is analyzed, to meet the needs of the plant, if the execution of the project requires external debt, select a financial institution that offers the best market conditions. For the organization, it is expected to have qualified and sufficient personnel to meet its goals [26].

The size of the plant depends on the market and indicates the production capacity in relation to the daily demand of the project. 312 days are considered to work (52 weeks of 6 working days each). See Table 8.

Table 8
Project Demand-Calculation of the Number of Bottles to Produce Daily

Year	Projected Demand	Stock 3%	Total	Bottles/Year [300 ml]	Bottles/Month [300 ml]	Bottles/Day [300 ml]
	Liters	Liters	Liters	Bottles	Bottles	Bottles
1	11 863	355,89	12 219	40 730	1 567	131
2	21 142	634,26	21 776	72 588	2 792	233
3	33 352	1	34 353	114 509	4 404	367
4	48 835	1	50 300	167 667	6 449	537
5	67 883	2	69 919	233 065	8 964	747

According to [31], the location specifies the place to install the production plant considering the macro location (region) and micro location (specific place) to install the plant [32]. To determine the micro location for the Project, the quantitative method by points was used, which consists of identifying the most important factors to locate the plant as shown in Table 9.

Table 9
Micro location factors

Factors	Symbol
Closeness to suppliers	FA
Social group development	FB
Closeness to potential customers	FC
Transport	FD
Weather	FE

Analyzing the three possible places for the location: Cercado de Lima, San Borja, San Miguel. Table 10 shows the complete procedure for selecting the micro-location.

Table 10
Micro-location Selection Matrix

District		San Miguel		Cercado de Lima		San Borja	
Factor	Weight (A)	Qualification (B)	Score (AxB)	Qualification (B)	Score (AxB)	Qualification (B)	Score (AxB)
A	20.00%	4	0.6	4	0.8	2	0.4
B	20.00%	2	0.4	3	0.6	4	0.8
C	30.00%	3	0.9	4	1.2	4	1.2
D	20.00%	3	0.6	4	0.8	4	0.8
E	10.00%	3	0.3	4	0.4	4	0.4
Total	100.00%		3.0		3.8		3.6

Finally, the watercress nectar processing plant will be in the department of Lima, in the Cercado de Lima district for having obtained a higher score (3.8) in the ranking of factors.

Lira [33], indicated that the economic-financial study shows the information of a monetary nature of the project's resources for the start-up; It also allows managers to make appropriate decisions, evaluate the future of investments, plan the investments to be made and estimate profits.

The income from the project is made up of the sale of 300 ml bottles of watercress nectar, hoping to obtain a total income of S/183,285.00 in the first year, and S/1,048,792.50 in the fifth year of operations. The sale price of watercress nectar per unit is S/4.50, which will be maintained during the five years of operation (see Table 11).

Table 11
Project Income Budget

YEAR	PRODUCTION OF LOTS PER 12 UNITS		
	UNITS ANNUAL		TOTAL (S/.)
2021	40 730		183 285.00
2022	72 588		326 646.00
2023	114 509		515 290.50
2024	167 667		754 501.50
2025	233 065		1 048 792.50
	Total revenue per sale	S/	1 779 723.00

The Net Present Value (NPV) updates the money flows with an opportunity cost of 12.93%, to show the gains or losses for the investment (Table 12).

Table 12
Economic Cash Flows

CONCEPT	2022	2023	2024	2025	2026
Economic cash flow	3 730.95	62 282.31	139 429.16	237 220.78	1218 331.62

The financial net present value requires knowing the flows from 2022 to 2025 (Table 13).

Table 13
Financial Net Present Value

CONCEPT	2022	2023	2024	2025	2026
Financial cash flow	(18 985.41)	39 565.96	116 172.81	214 504.42	1195 615.27

The Net Economic Present Value for the project is S/108 482.42. The Net Financial Present Value is S/5,903.21 (NPV > 0) which indicates that the investment will provide profits to the project.

To calculate the Benefit/Cost (B/C) ratio, it is necessary to know the income, expenses and economic cash flow from

2022 to 2026, obtaining 1.05 > 0, which shows that the execution is satisfactory and thus same the accumulated cash flow (see Table 14 and Table 15).
NPV of income = S/2 313 673.90
NPV of egress = S/2 205 191.47
Ratio B/C = 1.05

Table 14
Income, Expenses and Cash Flow

CONCEPT	2020	2021	2022	2023	2024	2025
Income	0,00	183 285,00	326 646,00	515 290,50	754 501,50	1 909 921,01
Expenses	861 128,51	179 554,05	264 363,69	375 861,34	517 280,72	691 589,39
Economic cash flow	(861 128,51)	3 730,95	62 282,31	139 429,16	237 220,78	1 218 331,62

Table 15
Economic cash flow accumulation

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Economic cash flow	(868 043)	3 730,95	62 282,31	139 429,16	237 220,8	1218 331,62
Accumulated cash flow	(868 043)	(86 4312,05)	(80 2029,74)	(66 2600,58)	(42 5379,80)	792 951,82

The internal rate of return (IRR) is the rate of return compared to the opportunity cost, the economic IRR was 15.55%, the Financial IRR was 13.09%; therefore, the investment is viable.
The capital recovery period (P. R/C) for the project is four years (2025), more precisely, 4.35 years, (see Table 15). Its calculation is given by:

$$PRI = A + \frac{|B|}{C},$$

being:
A – Last period with negative accumulated flow = 4
$|B|$ – Absolute value of the last negative accumulated flow = S⁄425 379.8
C – Value of cash flow in the following period = S⁄1 225 246.11
PRI = 4.35 years
The watercress processing plant is distributed in an orderly manner and has the necessary environments for the production factors, including the raw material, the route to the warehouse, the labor activities and the actions that conform the production system with capacity. to achieve the planned results [13].
The material resources for the installation and processing of watercress are raw material, suppliers, access to energy and land; Among the factors related to the process: access to data, IT services, consultancies and maintenance. Among the factors related to the product: proximity to the target market and the behavior of competitors, for machinery and equipment are distributors, prices, brands, models, operators, power consumption, and auxiliary equipment. Finally, the cost of transportation and insurance, the cost of installation, operation and maintenance.
The physical infrastructure requirements of the production plant, includes soil studies, records the disposition of machines and equipment following the sequence of the P.O.D. maintaining the specifications obtained by means of the Guerchet method to determine the space of the plant. The relational diagram of spaces obtains the proximity between the different areas of the company and their distance from them, allowing to determine the routes of movement of the mobiles within the plant.
The productive process to make watercress nectar is illustrated in the Process Operations Diagram (PDO), see Figure 2.

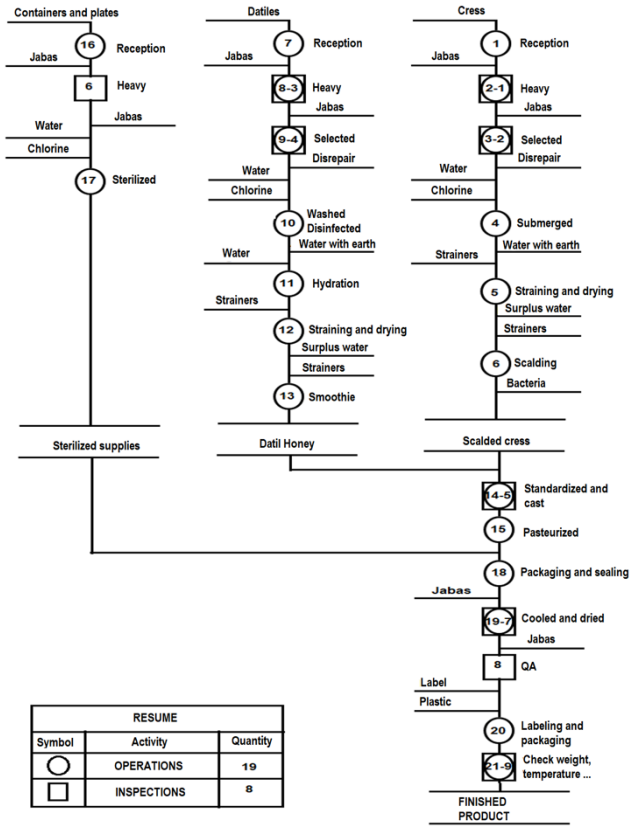

Fig. 2 Watercress Nectar Process Operations Diagram

The standard time it takes for a competent operator to carry out a specific activity, carried out according to a preestablished method, using the different evaluations of the activity and a 9% supplement (personal needs and complex processes), the basic time for each task is appreciated, see Table 16.

Table 16
Basic and Standard Time (Type) per Task

Activity	Weather Average (Minutes)	Assessment	Weather Basic (Minutes)	Supplements (9%)	Typical Time (Min)
Reception and heavy	32	100%	32.00	2.88	34.88
Selection	22	98%	21.56	1.94	23.50
Immersion	38	98%	37.24	3.35	40.59
Hydration	27	99%	26.73	2.41	29.14
Scalding	12	99%	11.88	1.07	12.95
Casting and drying	22	98%	21.56	1.94	23.50
Smoothie	12	100%	12.00	1.08	13.08
Standardized and cast	63	100%	63.00	5.67	68.67
Pasteurization	10	98%	9.80	0.88	10.68
Packaging and sealing	32	95%	30.40	2.74	33.14
Cooled and dried	32	98%	31.36	2.82	34.18
QA	30	100%	30.00	2.70	32.70
Labelled	27	80%	21.60	1.94	23.54
Packed	24	90%	21.60	1.94	23.54
Inspection and storage	30	98%	29.40	2.65	32.05

Table 17 identifies the necessary areas and their description to consider the processing of watercress nectar in the plant, taking into account that they are the minimum areas that are required, and there may be additional areas that allow improving the production process.

Table 17
Areas and Description of the Plant

AREA	DESCRIPTION
Reception and weighing area	It is the area where the providers will arrive for the reception of PM
MP warehouse and supplies	It is the area where all the necessary inputs for the production of our product will be stored
Production area	Watercress nectar will be manufactured in this area. In this way, it should be a large area and be close to the warehouse for a fast flow in the process
Labeling and packaging area	It is the area where once the product is finished, the labels will be placed on the containers for later packaging
Quality control area	The necessary tests will be carried out to guarantee the quality of the final product
Hygienic services area	It is an environment for collaborators who are working both in the production, labeling, packaging, quality control and administrative areas
Administrative Office	It is the office where customers and suppliers will be served; In addition, the records, controls, accounting, etc. will be carried out. In addition, it will have a space for sanitary and cleaning articles such as brooms, disinfectants, etc
Dining room	It is the area where collaborators can come to have a snack. This environment will be exclusive for employees who bring food as there will be no concessionaire
PT Warehouse	It is the area where we will store the PTs until they are distributed

Table 18 shows us the needs required to guarantee the continuity and flow of the distribution operations to be carried out within the watercress nectar plant.

Table 18
Reasons in the Distribution of LAYOUT

N°	REASONS	DESCRIPTION
1	Continuity	Route made by the raw material and semi-product within the production system.
2	Control	Possibility of monitoring that exists between areas to achieve an integrated quality control system.
3	Noise and/or vibrations	Seeks the emotional security and job satisfaction of the personnel who work in the plant.
4	Security	Confer characteristics to the plant that provide physical guarantees to workers.
5	Energy	Achieve proximity to areas that are related to energy consumption (electricity, cold or steam).
6	Circulation	Route made by personnel within the production system or direct labor.

In the same way, the parameters of the Guerchet method are displayed in Table 19.

Table 19
Guerchet Method Parameters

ELEMENTS	DESCRIPTION
n	Amount of items required
N	Number of operation sides
Se	Static surface: Se = Length x Width
Sg	Gravitational surface: Sg = N x Se
K	Evolutionary surface coefficient = 0.5x (hm/hf)
hm	Average number of mobile teams
hf	Fixed equipment average
Sev.	Evolutionary surface = K x (Se + Sg)
ST	Total area = n x (Se + Sg + Sevo.)
K	K = height of mobile element/< 2*h Immovable element

Then, according to what was previously reviewed in this study, thirteen essential areas are determined for the production process that the plant needs, these areas require a space for the necessary operation, which have been determined based on the dimension of the surface area, see Table 20.

In the relational table of SLP activities, it is common to identify the needs by means of a letter code, through a scale that decreases with the order of the five vowels: A (absolutely necessary), E (especially important), I (important) , O (ordinary importance) and U (not important); what is unwanted is regularly represented by the letter X, see Figure 3.

Table 20

Dimensions of the plant zones

RESUME		
	ZONES	**SURFACE (m²)**
1	Hienic services area	6.22
2	Administrative area	5.03
3	Storage area for finished products	4.24
4	Raw material and supplies storage area	6.48
5	Reception and heavy area	3.52
6	Dining area	15.09
7	Quality control area	7.28
8	Sterilizing area for containers and sheets	3.87
9	Hydration, scalding, standardized and pasteurized area	11. S5
10	Dive area	5.36
11	Cooling and drying area	5.66
12	Packaging and sealing area	5.50
13	Labeling and packaging area	4.37
	Total	85.47

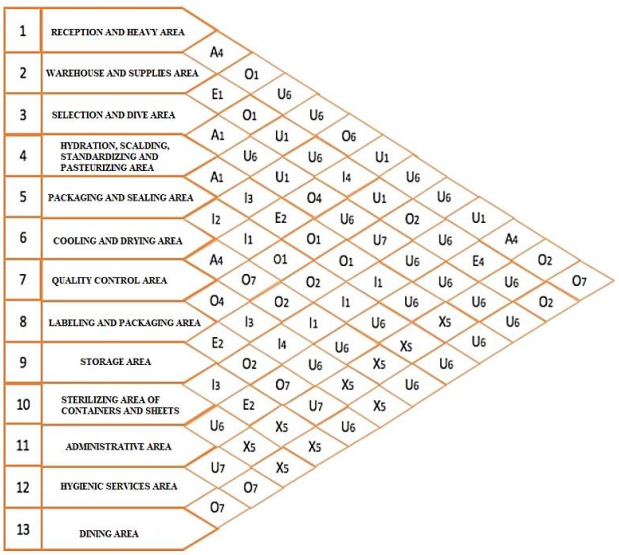

Fig. 3 Relational table of activities

From the relational table of activities, where the priority has been identified, the amount of participation between the activities to be developed with a greater or lesser number of lines is determined. The following diagram is adjusted through trial and error, to minimize the number of crossings between the lines that represent the relationships between the activities, or at least between those that represent a greater relational intensity (see Figure 4). The next step is to establish the quantity and the sequence of the movements of the products through the different operations during their processing. From the information on the production process and production volumes, descriptive graphs and diagrams of the flow of materials are made. The route is illustrated in Figure 5.

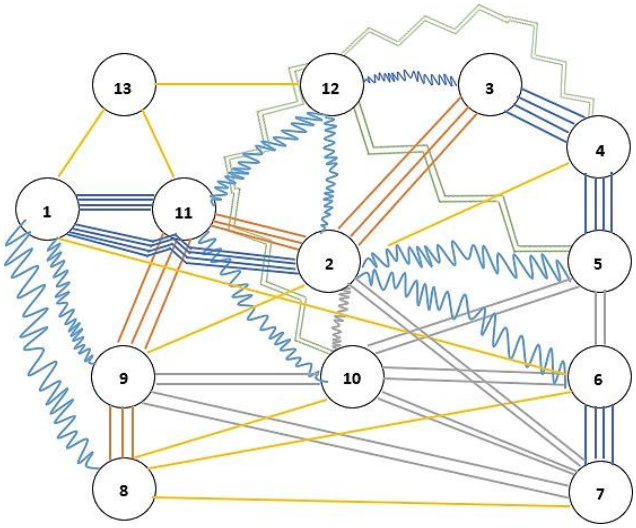

Fig. 4 Relational Activity Diagram

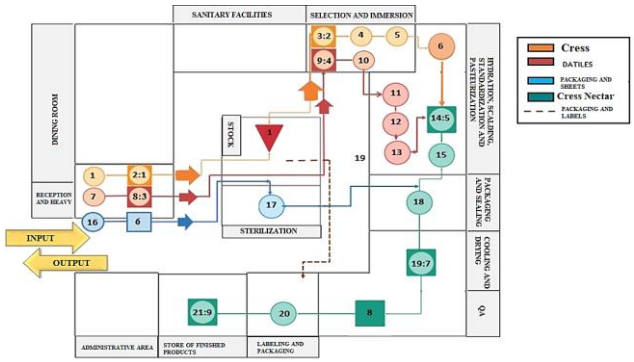

Fig. 5 Stroke diagram

If this is the case, various space calculation procedures can be carried out to improve the required estimate of the area for each activity. The data resulting from the estimate must be corroborated with the real availability of the space. When the need for space is greater than the availability, it is necessary to modify, reducing the forecast surface requirement for activities, failing that, increase the total surface area available by modifying the original project, considering the facilities in the building.

RESULTS OF RESEARCH

The demand for nectar was calculated based on the historical demands of zones 6 and 7 of Lima, with the polynomial model that best adjusts to the demand for having obtained a correlation coefficient R = 0.9951, which allowed visualizing the consumption of nectars; It was calculated based on 65.3% of the unsatisfied demand due to 3.0% of this demand, resulting in 1.959%, for the first year of operation, then it was proposed that each following year, it will increase by 0.5% to the target market, see Table 21.

Table 21
Nectar demand in millions of liters

YEAR	Project demand (Millions of Liters)
Year 1	11863
Year 2	21142
Year 3	33352
Year 4	48835
Year 5	67883

The watercress nectar processing plant will be located in Cercado de Lima for having obtained a higher score (3.8) in the ranking of macro and microlocation factors with respect to the districts of San Miguel and San Borja (see Table 10).
For the size of the plant, 312 days to work are considered (52 weeks of 6 working days each) and the annual demand for watercress nectar was calculated, see Table 22.

Table 22
Demand for watercress nectar in bottles of 300 ml

YEAR	Bottles/year (300 ml)
Year 1	40 730
Year 2	72 588
Year 3	114 509
Year 4	167 667
Year 5	253 065

In the DOP of watercress nectar, the structure of the production process is observed (19 operations and 8 inspections); For the calculation of the standard time per task, 9% of supplements were considered. The processing area of the watercress nectar plant will be 85.47 m^2 (Güerchet method) and the areas were located considering the grade of proximity with their respective ratio between them. With the relational diagram and the DOP, the path diagram was elaborated, see Figure 5.
The economic-financial study for the start-up of the watercress nectar processing plant for five years of operation, indicated that the Net Economic Present Value for the project is S/108 482.42 greater than the Net Financial Present Value that is S/5,903.21; the internal rate of return (IRR) economic was 15.55% and the financial IRR was 13.09%; In calculating the Benefit/Cost ratio, 1.05 > 0 is obtained, and the capital recovery period is 4.35 years. The economic-financial indicators shown indicate that the investment is viable, and the execution of the project is satisfactory, see Table 23.

Table 23
Values of Financial Evaluation Indicators

FINANCIAL EVALUATION INDICATORS (S/.)	
Net Present Value economic	108 482,42
Net Present Value financial	5 903,21
Internal Rateo of Return economic	15,55%
Internal Rateo of Return financial	13,09%
B/C	1,05
PRI	4,35

The web questionnaire allowed obtaining more detailed information on the consumption of juices and nectars, helped to identify the level of acceptability of the product, and provided information to make some adjustments regarding the presentation, sale prices, advertising, among other aspects, it was shared via online to the target audience oriented to the areas indicated considering the sample, made up of 384 people, all adults over 45 years of age. The main results of the information obtained from the web form used, which consisted of 12 questions, about nectar consumption are described below.

- 88% of those surveyed prefer to consume nectars.
- 37% consume nectars twice a week and 25% three times a week.
- 60% of those surveyed prefer nectars of natural origin.
- 62% of those surveyed are attracted to tasting juice nectars and/or little-known fruit or plant nectars.
- 43% of respondents consider that they consume nectars for health reasons.
- 41% of those surveyed prefer to buy nectars at the supermarket.
- 25% of those surveyed prefer the “Frugos” brand of juices/nectars.
- 78% of respondents prefer 300 ml containers, at a price between 3 and 5 soles.
- 84% of those surveyed do not know the properties and/or benefits of watercress.
- 84% of those surveyed have not consumed watercress in food or in any other product.
- 65.30% are interested in consuming watercress nectar.
- 31.95% indicate that the product is healthy and 10.68% that it is inexpensive.

DISCUSSION

The economic-financial indicators calculated in our project indicate that the investment is viable and the execution of the project is satisfactory, coinciding with Zafra [9], who in his research indicated that “the viability of the production and marketing of fruit nectars and vegetables, improve the health and quality of life of consumers; proving to be a good business opportunity in Metropolitan Lima”; with Mamani [12] who demonstrated the benefit of an apple drink with quinoa using economic-financial indicators and the survey technique and concluded the viability of his project; Also with [6] who determined the profitability and the period of recovery of the investment in a company that sells nectar for anemia, applying the survey technique to 400 people, showing satisfactory economic indicators from the first year of its installation, fully coinciding with the results of our project.
In our project, 88% of those surveyed prefer to consume nectars and 60% nectars of natural origin and in a similar proportion nectars from fruit or plant juices; In this regard, [34] justified that with the industrialization of watercress nectar as a natural resource, innovative and at the same time exotic, easy to digest, with a pleasant taste and its nutritional properties, it favors the care and monitoring of the health of the age group of our target market, generating expectations of consumption and production in quantities; open new markets generating new jobs con-

firming that watercress is a plant that contains varied nutrients, in sufficient quantities to improve the amount of iron, and generation of hemoglobin in the blood, being sufficient to combat anemia, complementing the study by [10] which measured the daily needs of the amounts of nutrients in uncooked foods and calculated the percentages in raw foods according to daily needs, finding that watercress topped the relationship with a final 100% percentage, becoming the ideal food to reduce anemia; Furthermore, [11] states that the presence of watercress in the food menu is important to improve health. Due to what was stated in previous paragraphs, this investigation coincided with the investigations carried out and considered as antecedents; so, its installation is highly viable.

CONCLUSIONS

The technical study of the installation of a nectar processing plant to reduce anemia in adults in Lima was viable in terms of operation and profitability, taking advantage of its curative and nutritional properties.

The demand for the nectar project was calculated based on the historical demand of zones 6 and 7 of Lima and 65.3% of the unsatisfied demand for 3.0% of this demand, resulting in 1.959% for the first year of operation, will increase by 0.5% for each following year for the target market.

The watercress nectar processing plant will be in Cercado de Lima, with an area of 85.47 m^2, for the calculation of the standard time, 9% of supplements were considered and based on the PDO and the relational diagram, the zones were ordered definitively for the layout; the presentation of the product will be in 300 ml bottles.

The project is completely viable, since all the indicators have provided satisfactory results: the NPV and IRR indicators were positive and satisfactory, the NPV E was S/108 482.42 and the NPV F of S/5 903.21 (greater than zero). The IRR E and the IRR F were 15.55% and 13.09% respectively, they are higher than the weighted cost of capital and the benefit/cost ratio (B/C) was 1.05 and the capital recovery period (PRI) was 4.35 years.

The practical implications of the results obtained determine that the watercress nectar processing plant can be implemented in a reduced area of 85.47 m^2, being a highly attractive proposal, once the consumption of the product is installed, it will be able to prevent anemia, avoid bad liver function, as well as control diabetes among other diseases detected in adults over 45 years of age, as has been shown in the present investigation.

The perspective of the authors at the end of this research motivates us to continue developing new research that significantly contributes productive processes focused on low cost and that improves the quality of life.

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