ECONOMIC VIABILITY TO PRODUCE CAVIAR SUBSTITUTE USING ROES OF RAINBOW TROUT*

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ABSTRACT

Roes of rainbow trout (*Oncorhynchus mykiss*) can be used to produce caviar substitutes, resulting in a high-value added product. This study evaluated the market potential of rainbow trout roe in Campos do Jordão City (São Paulo State, Brazil) (22°44'20"S, 45°35'27"W) and the economic aspects of its production, considering two scenarios: production in existing processing plants (scenario A) and building a plant for its production (scenario B). To estimate the net present value rates (NPV), we used different asking prices (US$ 8.50, US$ 10.00 and US$ 12.50) and interest rates (11%). The market research indicated a great potential for the caviar substitute, perceived as a differential in gastronomy. The results showed economic viability in scenario A, with satisfactory profitability and return on venture capital for the short-term at different prices. In scenario B, economic viability is attained at the highest price, US$ 12.50; all other simulations require careful consideration from the investor.

Keywords: *Oncorhynchus mykiss*; production costs; return on investment; value added

VIABILIDADE ECONÔMICA DA PRODUÇÃO DO SUCEDÂNEO DE CAVIAR DE OVAS DA TRUTA ARCO-ÍRIS

RESUMO

Ovas de truta arco-íris podem ser utilizadas para a confecção de sucedâneo de caviar, resultando em produto de alto valor agregado. Este estudo objetivou avaliar o potencial de mercado do produto no município de Campos do Jordão – SP (22°44'20"S, 45°35'27"W), e os aspectos econômicos da sua produção nas seguintes simulações: produção em estrutura de processamento previamente existente (simulação A), construção de estrutura específica para sua produção (simulação B), diferentes preços de venda (R$ 19,00; R$ 22,50 e R$ 28,00), e taxa de juros de 11% para estimativa do valor presente líquido (VPL). O estudo de mercado indicou grande potencial para o sucedâneo, visto como diferencial na gastronomia. Os resultados demonstraram a viabilidade do investimento para todas as simulações da condição A, com alta rentabilidade e recuperação do investimento em curto prazo. A condição B apresentou viabilidade apenas para o preço de US$ 12.50; todas as outras simulações para esta condição requerem análise cuidadosa por parte do investidor.

Palavras chave: *Oncorhynchus mykiss*; custos de produção; retorno sobre os investimentos; valor agregado

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INTRODUCTION

Caviar, a product made from the roes of sturgeon fish, *Acipenseridae* family, is synonymous to gastronomic sophistication due to its high price and delicacy trait (FLYNN *et al*. 2006). Currently, alternative products called "caviar substitutes" are produced from eggs of other fish species, including salmonids (JOHANNESSON, 2006).

The rainbow trout (*Oncorhynchus mykiss*), from the Salmonidae family, was introduced in Brazil in 1949 as an initiative of the Ministry of Agriculture to populate rivers of mountainous regions. The trout is also farmed in Brazil and trout farms are characterized as family-type agricultural ventures due to limited water resources for trout farming, resulting in a low-production scale. The economic sustainability of this activity depends on the use of technologies to increase productivity and to produce value-added products (TABATA and PORTZ, 2004). The use of trout roes in caviar production is an alternative to sturgeon caviar. In addition to environmental responsibility, caviar produced from trout roe has as high value-added and is less expensive than sturgeon caviar.

An enterprise can benefit from an opportunity by operating in new markets when demand is unknown (BARON, 2007), as is the case of the market of caviar substitutes. However, the identification of opportunities is only the first step in the entrepreneurial process to provide support to all the other phases in the business (OZGEN and BARON, 2007). To set up a business is a relevant dimension of entrepreneurship and involves the identification, evaluation and exploration of a profitable opportunity (SHANE and VENTAKARAMAN, 2000).

The analysis of economic viability aims to identify the expected benefits of a venture and compare them to investments and costs to assess its feasibility. A market research is an important tool that allows identifying the economic viability of the activity (ROSA, 2004).

This study aimed to evaluate the market potential of caviar substitutes using rainbow trout roes in the city of Campos do Jordão, São Paulo State, Brazil, and the economic aspects of their production by projecting costs and revenues to measure the viability of the venture.

MATERIAL AND METHODS

We conducted a market research between July 23-27, 2013 and surveyed restaurants and hotels in the city of Campos do Jordão - São Paulo State (22° 44′ 20″ S, 45° 35′ 27″ W). Campos do Jordão plays an important role in trout consumption in Brazil.

We used a questionnaire with objective questions to detect the interest in caviar substitutes using trout roes in menus at restaurants in Campos do Jordão City (SILVA *et al*., 2011). We surveyed 19 businesses, being four restaurants with varied cuisine; three trout-specialized cuisine; two hotel restaurants; two bistros and eight multi-cuisine restaurants (Portuguese, Italian and German).

Based on the surveys, we constructed a matrix in which each column corresponds to a category level to obtain the relations between the multiple-path categories. To intercept the data, we used the analysis of multiple correspondences, which allows to visualize the trends in complex datasets in two dimensions (PITTS *et al*., 2007; WHITLARK and SMITH, 2001). According to VANCE *et al.* (2008), the analysis of multiple correspondences allows to identify associations between categories. Categories with near location in the plain projection have a stronger relation than those separated at greater distances (FÁVERO *et al*., 2006).

For the economic analysis, we simulated two scenarios: scenario A (the use of the existing structure for fish processing) and scenario B (the construction of a processing plant for caviar substitutes). The installations for caviar substitutes must comply with requirements from Regulation of Industrial and Sanitary Inspection of Animal Products (BRASIL, 1952). In scenario A, we considered only the acquisition of material for permanent use (pasteurizer, industrial fridge, digital pH meter, thermograph, autoclave, oven, stainless steel stand, digital scale, semi-analytical scales, stainless steel cabinet, technology apparatus) and consumables (containers, boxes and polypropylene spatulas) required for the production of caviar substitutes. In scenario B, a piece of land (0.5 ha) was acquired and workforce was outsourced to build a 200m^2 processing plant. All materials for permanent use and consumables were purchased (including a motor vehicle). The operational cost of the project was 3% above the venture capital.

For both scenarios, two professionals at technical and administrative levels were hired for two Brazilian minimum wages per month (one minimum wages equivalent to US$ 322.00). The entrepreneur received an income of 10 minimum salaries per month. Social security accounted for 40% of the wages; 24% a year over the initial venture in the land piece and 12% a year for the other items; financial charges of 28% a year over the half of the effective operational cost added to social charges.

The roes for the production of the caviar substitute may be obtained during the trout spawning (May-August) from producers in the southeastern and southern regions in Brazil (Minas Gerais, São Paulo, Rio de Janeiro and Santa Catarina States). In the subsequent months, if necessary, the roes can be imported from producers in Chile and United States. The average price for a kilo of roes, domestic and imported, was fixed at US$ 30.00 based on prices practiced in specialized websites.

Based on the volume of caviar and caviar substitutes that São Paulo State imports, 5,231 kg in 2010 (ALICE WEB, 2010), we estimated an initial average production of 100 kg per month, which would amount to 1.2 ton-year^{-1}, using flasks with metallic lids with capacity for 40 g of the product, totaling 2,500 flasks of caviar substitute of trout roes per month and 30 thousand a year. We evaluated the asking prices of US$ 8.50, US$ 10.00 and US$ 12.50 per 40 g flask and net present value (NPV) of 11%.

In the current study, we used the structure proposed by MATSUNAGA *et al.* (1976), adapted by HENRIQUES *et al.* (2010), to characterize the production costs of caviar substitutes:

- Effective Operating Costs (EOC): expenses regarding labor force, rent, acquisition of trout roes and inputs, tanks, fuel, cleaning products, water, electricity and telephone bills;

- Total Operating Costs (TOC): expenses deriving from permanent labor force comprising the sum of EOC plus social charges (40% over EOC); plus financial charges (28% a year over half of the EOC) to purchase the trout roes and inputs, tanks, fuel, cleaning products, and water, electricity and telephone; plus the estimated depreciation of the useful life of equipment, utensils, computer, printer and vehicle;

- Total Production Cost (TPC): the sum of TOC plus costs derived from annual depreciation of installations and annual interests over the venture capital.

The analysis of economic viability for the production of caviar substitute, in the different scenarios studied, considered a 10-year horizon with the venture capital entirely invested in year zero. The analysis of return on investment considered the concepts described in MARTIN *et al.* (1998):

- Gross Income (GI): the revenue of producing flasks of caviar substitutes of trout roes per year multiplied by the asking price of each flask;

- Cash Flow (CF): the sum of inflows and outflows during the activity cycle over the TPC;

- Operating Profit (OP): the difference between GI and TOC. This index measures profitability for the short-term, showing the finance and operating conditions of the activity. Therefore: OP = GI – TOC;

- Gross Margin (GM): the profit margin in relation to TOC, that is, the result after the deduction of operating costs, considering the asking price of the kilo of caviar and the productivity of the activity. Therefore: GM = (GI – TOC)/TOC x 100;

- Profitability Index (PI): the ratio between OP and GI, in percentage. An important index shows the rate of income available for the activity after deducting all operating costs. Therefore: PI = (OP/GI) x 100.

To calculate the cash flow, we considered in scenarios A and B, the expenses related to the venture capital (first year) and effective operating cost plus financial charges, social charges and labor force and annual interest over the venture. In 10 years, half of the value of structure was added in scenario B and 20% of this value to scenario A. To demonstrate which investment will generate better or faster return on investment, we used the Internal Rate of Return (IRR), Payback Period (PP) and Net Present Value (NPV).

When we use IRR to evaluate a project, we observe that it is economically viable only when the rate exceeds a certain attractiveness rate

(SANCHES *et al.*, 2013). The Minimum Attractiveness Rate (MAR) corresponds, in practice, to the rate offered by the market for a venture capital and suggests that, if the investment provides a return below market financial investments, the investment will not be attractive to the investor (TAHA, 1996; SANCHES *et al.*, 2013). In this research, the MAR considered was 11% per year, equivalent to interest that could be received from investments (Selic Rate, June 2014), and higher than the available bank loan (5.5% per year offered by Credit Costing Bank of Brazil to Agribusiness). The VAT (ICMS) was calculated at 18% on the final sales cost of the product. In this study, we evaluated the NPV at interest rate of 11% (equivalent to Selic Rate).

The PP represents the period to recover the venture capital (GITMAN, 1997). It is also considered the cost index regarding the flasks produced, denominated Breakeven Point (BP), which determines the minimum production necessary to cover costs, based on the asking prices of caviar, according to the formula: BP = TOC/P_{caviar} (HENRIQUES *et al.*, 2010).

RESULTS

Figure 1 show that there is great interest in caviar substitutes using rainbow trout roes in food establishments surveyed in the city of Campos do Jordão, highlighting some producers who use and sell the product to international restaurants. To Bistros and hotel restaurants, the price is not the most important factor, the possibility to work with larger packages at events is proposed by multi-cuisine restaurants, and the regularity of supply it is a concern cited by 95% of respondents.

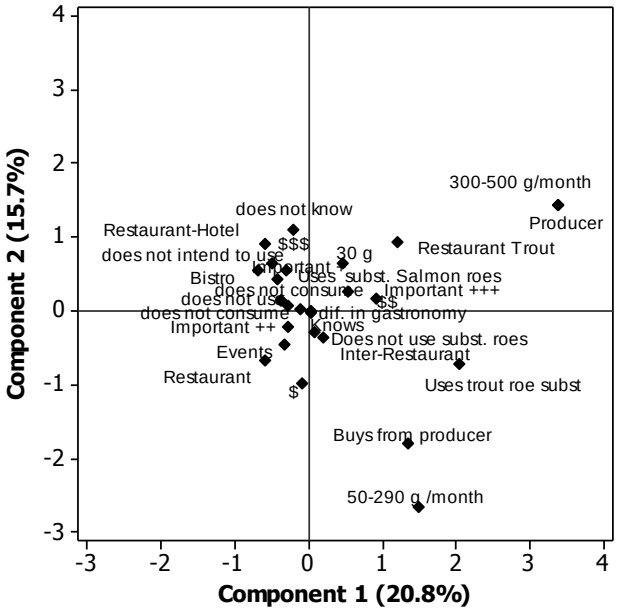

Figure 1. Distance between MCA categories obtained from the surveys on caviar substitutes using roes of rainbow trout (*Oncorhynchus mykiss),* conducted at restaurants in the city of Campos do Jordão, in July, 2013.

The investments required to produce caviar substitutes in scenarios A and B are described in Table 1. For scenario B, the venture capital was US$ 183,468.75, and land acquisition, construction, motor vehicle purchase and project preparation accounted for 88.42% of this amount.

Table 2 shows the operating cost per cycle (12 months) for the production of caviar substitutes, in scenarios A and B. In scenario A, the estimated EOC is higher than the venture capital, mainly because of the entrepreneur's remuneration and acquisition of raw materials (fish roes). In scenario B, the effective operating costs (EOC) correspond to 78.31% of the venture capital. In scenario A, the rent was charged, and 20% was applied to the operating cost related to fuel, cleaning supplies, water, electricity, telephone bills, construction and vehicle depreciation to minimize errors that could lead to poor choices.

Table 1. Venture capital for the production of caviar substitutes using roes of rainbow trout (*Oncorhynchus mykiss*), June 2014, scenarios A and B. Values expressed in US dollars.

Item	Total price	Useful life and replacement[1]	Annual depreciation (a)	Annual interests of capital[2] (b)	Sum (a)+(b)
1. Acquisition of land (1 ha)	22,500.00	-	-	5,400.00	5,400.00
2. Construction - Processing plants (200 m²)	100,000.00	20	5,000.00	12,000.00	17,000.00
3. Equipment and utensils	20,625.00	5(1)	4,125.00	2,475.00	6,600.00
4. Vehicle	35,000.00	10	3,500.00	4,200.00	7,700.00
5. Documents and project preparation (3%)	5,834.07	-	-	1,400.18	1,400.18
Total general scenario "A" (US$)	**21,243.75**	**-**	**4,125.00**	**2,549.25**	**6,600.00**
Total general scenario "B" (US$)	**183,468.75**	**-**	**12,625.00**	**25,357.50**	**37,982.50**

[1]*Useful life and replacement ( ) in years*
[2]*Rate of 24% per year over the venture capital*
Scenario A: production using existing structure; Scenario B: construction of a specific structure for the production. Source: survey data

Table 2. Operating cost per cycle (12 months) for the production of caviar substitutes using roes of rainbow trout (*Oncorhynchus mykiss*), June 2014, scenarios A and B. Values expressed in US dollars.

Item	Effective Operating Costs (EOC)	Social charges[1]	Financial charges[2]	Operating Cost (TOC)	Other fixed costs	Total Production Cost (TPC)
1. Permanent labor force (A and B)						
1.1. Operational technical	15,445.33	6,178.13	3,027.29	24,650.75		24,650.75
1.2. Administrative technician	7,722.67	3,089.07	1,513.64	12,325.38		12,325.38
1.3. Entrepreneurs	38,613.33	15,445.33	7,568.21	61,626.88		61,626.88
2. Rent for use of the structure (scenario "A")	12,000.00		1,680.00	13,680.00		13,680.00
3. Roes (A and B)	36,000.00		5,040.00	41,040.00		41,040.00
4. Acquisition of inputs (A and B)	600.00		84.00	684.00		684.00
5. Acquisition of flasks (A and B)	12,000.00		1,680.00	13,680.00		13,680.00
6. Acquisition of fuel (B)	1,800.00		252.00	2,052.00		2,052.00
6.1. Acquisition of fuel (A)	360.00		50.40	410.40		410.40
7. Acquisition of cleaning products (B)	1,500.00		210.00	1,710.00		1,710.00
7.1. Acquisition of cleaning products (A)	300.00		42.00	342.00		342.00
8. Water, electricity and telephone bills (B)	30,000.00		4,200.00	34,200.00		34,200.00
8.1. Water, electricity and telephone bills (A)	6,000.00		840.00	6,840.00		6,840.00
9. Depreciation of installation[3] (B)					5,000.00	5,000.00
9.1. Depreciation of installation[3] (A)					1,000.00	1,000.00
10. Dep. of the equip. and utensils[3] (A and B)				4,125.00		4,125.00
11. Depreciation of vehicle[3] (B)				3,500.00		3,500.00
11.1. Depreciation of vehicle[3] (A)				700.00		700.00
12.Interests over the venture capital (B)					27,436.45	27,436.45
12.1. Interests over the venture capital (A)					2,549.25	2,549.25
Total/year scenario "A"	**129,041.33**			**180,104.41**		**183,653.66**
Total/year scenario "B"	**143,681.33**			**199,594.01**		**232,030.46**

[1]*Social charges = 40% of the income*
[2]*Financial charges = 28% a year over half of the EOC plus social charges*
[3]*Estimated depreciation based on the useful life*
Scenario A: production using existing structure; Scenario B: construction of the specific structure for the production. Source: survey data.

Considering the prices of caviar substitutes practiced in the domestic and international markets, we evaluated the asking prices of US$ 8.50, US$ 10.00 and US$ 12.50 per flasks 40 g. We calculated production costs for flasks (production of 2,500 flasks monthly and 30,000 flasks annually), resulting in values of total production costs (TPC) of US$ 6.12 for scenario A and US$ 7.73 for scenario B (Table 3).

The cost analysis and profitability indexes for the production of caviar substitute using roes of rainbow trout, in scenarios A and B, are shown in Table 4. We observe that the IRR and NPV showed higher values for scenario A than in scenario B, for the three stipulated asking prices.

Except for price US$ 8.50, profitability ratios were greater than 11% of MAR for both scenarios, suggesting the feasibility for the 10-year horizon. BP showed scenario A, with the asking price US$ 12.50 as the most favorable (18,773.66 flasks 40 g).

Table 3. Production costs of flasks 40g of caviar substitutes using roes of rainbow trout (*Oncorhynchus mykiss*), June 2014, scenarios A and B. Values expressed in US dollars.

Cost of production/packaging 40g	Scenario "A"	Scenario "B"
Effective Operating Costs (EOC)	$4.30	$4.79
Total Operating Costs (TOC)	$6.00	$6.65
Total Production Cost (TPC)	$6.12	$7.73

Source: survey data

Table 4. Cost and profitability analysis of the investment in the production of caviar substitutes using roes of rainbow trout (*Oncorhynchus mykiss*), June 2014, scenarios A and B.

Indices	Scenario "A"			Scenario "B"		
Cash Flow - flask - 40 g (US$)	8.50	10.00	12.50	8.50	10.00	12.50
Gross Income (US$)	209,100.00	246,000.00	307,500.00	209,100.00	246,000.00	307,500.00
Operating Profit (US$)	16,670.00	53,570.00	115,070.00	-2,819.50	34,080.50	95,580.50
Gross Margin (%)	8.67	27.87	59.86	-1.33	16.08	45.10
Profitability Index (PI) (%)	7.97	21.78	37.42	-1.35	13.85	31.08
Internal Rate of Return (IRR) (%)	78.34	252.17	541.67	-15.26	14.99	51.50
Net Present Value (NPV) - 11% (US$)	80,451.59	297,764.25	659,952.02	-182,464.22	34,848.45	397,036.21
Breakeven Point (BP) (nº flask - 40 g)	27,608.32	23,467.32	18,773.66	31,629.78	25,843.84	20,675.07
Payback Period - (year)	1.33	0.39	0.18	-	5.38	1.92

Source: survey data.

DISCUSSION

Campos do Jordão is located in the Serra da Mantiqueira, São Paulo State, at 1,639 meters above sea level. It is a resort town and popularly called in Brazil as "Brazilian Switzerland" for its architecture based on European buildings, and its cooler climate with temperatures below that of the Brazilian average. It is 173 km distant from the city of São Paulo, which favors the presence of many tourists, especially during the winter season. The city of Campos do Jordão has its name closely linked to trout consumption. Trout farming is strongly related to this region involving the local community in cultural and gastronomic activities (SATO *et al.*, 2011).

Recently, Brazil has shown significant social and economic improvements evidenced by the consumption standards and income growth of the population. The Brazilian consumer evolved from consuming simpler to more sophisticated foods (FECOMERCIOSP, 2012). From 2001 to 2010, imports of caviar and caviar substitutes rose 758%, showing the huge potential for these products in the country, mainly in São Paulo State, Brazil's largest importer (75% of national import) (ALICE WEB, on line), possibly due to the

expansion of Japanese restaurants that traditionally to use fish roes in their dishes, such as temaki, sushi and others.

The interpretation of multiple correspondence analysis (MCA), based on points found in approximately the same direction and region of origin, shows this market increase. Bistros and hotel restaurants represent an important market to be explored, where the price caviar substitutes is not the most important factor. The possibility to work with larger packages at events is also an interesting option proposed by multi-cuisine restaurants, because it results in lower costs and contributes to the widespread and consequent increased consumption of this delicacy (Figure 1). The regularity of supply, a concern cited by 95% of respondents, can be solved by a better organization of the productive sector, using technologies, such as the photoperiod, to control the reproductive period of trout (NAVARRO and NAVARRO, 2012), or even imports of roes.

The low venture capital for scenario A, US$ 21,243.75, can be considered attractive for entrepreneurs seeking to diversify their products; however, LUNGA *et al.* (2008) recommend that, to obtain economic viability in an activity, one must consider several indexes to ensure inferences about the results.

Prices of caviar substitutes in international markets range from US$ 11.00 to US$ 36.00 for roes of trout, in flasks 28 g (www. caviargalore.com; www.caviarstrakhan. com). The caviar substitute using salmon roes, produced by a national company, is traded in the Brazilian market for US$ 15.00 to US$ 23.50 in flasks for 100g (www.damm.com.br).

Estimates of TPC per flask in both scenarios (A and B) show values lower than the prices stipulated for flask (US$ 8.50, US$ 10.00 and US$ 12.50). However, with 18% VAT calculated on the asking price of the product, the figures reduced to US$ 6.97, US$ 8.20 and US$ 10.25, and the price of US$ 8.50 in scenario B shows to be economically unfeasible.

The IRR values were higher than MAR values considered in this study, 11% per year, and proved to be attractive when compared to lower risk investments in the financial market, a result that, according to PENA *et al.* (2011), increases the safety margin of investment in the activity. Scenario B had an asking price US$ 8.50 and showed IRR below MAR, therefore it proved to be economically unfeasible.

For scenario A, the IRR showed high values; however, the study on technical and economic feasibility of surimi production, TAHA (1996) also obtained high values for the IRR, demonstrating viability of the project with highly satisfactory return.

The PP allows to visualize when the project will return the investment (GITMAN, 1997). The longer the period of time to recover the capital invested, the greater the risk of the project (SABBAG *et al.*, 2013). The results show that in scenario A, with suggested asking prices, the venture capital will have a return in the short-term (less than one year). According to GITMAN (1997), if the PP is shorter than the maximum acceptable period by the owners, the project is accepted; if the PP is longer than the maximum acceptable period, the project is rejected.

In scenario B, the asking price US$ 12.50 shows feasibility, with PP in about 1.92 years. The selling price US$ 10.00 requires further assessment, because it shows PP in about 5.38 years, which may undermine the project. Competitiveness of the enterprise in the market as well as its sustainability depends on high NPV and short PP (PENA *et al.*, 2011); therefore, selling the product at US$ 8.50 indicates risks to the investment, since there is no return of the amount invested.

The NPV values above zero indicate minimal recovery of venture capital (SOUZA *et al.*, 2009). With the exception of the asking price US$ 8.50 for scenario B, which showed negative NPV values, all other possibilities have values above zero, suggesting economic viability. According to GITMAN (1997), if the NPV of future cash flow of a particular project is greater than its venture capital, the project is recommended for acceptance. On the other hand, if the NPV is lower than the venture capital, the project should be rejected, because of high risks of loss. Therefore, scenario B with the asking price of the product at US$ 10.00 per pack and rate 11%, despite the NPV above zero, poses a risk to the entrepreneur.

CONCLUSIONS

The market research indicated a great potential for the caviar substitute, perceived as a differential in gastronomy. The results showed economic viability in scenario A, with satisfactory profitability and return on venture capital for the short-term at different prices. In scenario B, economic viability is attained at the highest price, US$ 12.50, however, all other simulations require careful consideration from the investor.

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