An Economic Added Value Analysis of Ready-To-Drink Prebiotic Candidate Milk

Silvia Oktavia Nur Yudiastuti[1](✉), Saiful Anwar[2], Yossi Wibisono[1], Agung Wahyono[1], Anna Maria Handayani[3], Annisa'u Choirun[1], Resti Pranata Putri[1], and Findi Citra Kusumasari[3]

[1] Department of Food Engineering, Politeknik Negeri Jember, Jember, Indonesia
silvia.oktavia@polije.ac.id
[2] Department of Renewable Energy Engineering, Politeknik Negeri Jember, Jember, Indonesia
[3] Department of Food Industrial Technology, Politeknik Negeri Jember, Jember, Indonesia

Abstract. This current research aimed to investigate the value added of RTD Prebiotic Candidate Milk which is enriched by xylose as a prebiotic candidate. Xylose is a pentose sugar with functional properties as an anti-diabetic agent by repairing pancreatic cells. Its sweetness level is as sweet as sucrose. The study was designed descriptively and the Hayami and Kawagoe method was used to analyze the value-added of RTD prebiotic candidate milk. The study showed that raw milk processing into RTD prebiotic candidate milk gave 25,644 IDR/kg value added to its raw milk with a value-added ratio of 32.82%. The result was higher than processing it without xylose as prebiotic-added which only gave the added value of 3,141 IDR/kg with a value-added ratio of 7.44%. The profit would be earned was 24,993 IDR/kg with a profit rate of 97.46%. Based on the added value and profit gained, xylose as prebiotic addition to RTD Milk formulation is feasible to be developed because it provides benefits for business owners. The business owner's profit would be owned was 51.74% of the product sales profit.

Keywords: Functional Food, Hot Filling, New Product Development, Pasteurize Milk, Retort

1 Introduction

RTD milk become trending these days since it`s the easiest to consume and is claimed to be the most nutritious milk. The most nutritious since the production process was done in a short time compared to other milk product variances [1]. RTD milk can be consumed directly or consumed as an additional, main, or complementary ingredient to food and beverages and it is generally used by many business actors to make various types of drinks and product variations. The marketplace of RTD products nowadays more emphasis on fresh milk which is processed through various heating processes to ensure its safety, such as pasteurization, sterilization, and Ultra High-Temperature processes [2], [3]. The new RTD dairy product range is limited to a wide variety of flavours to make it endearing to consumers.

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In the market, there is also RTD milk with certain functional properties, including RTD milk which can lower cholesterol, but it is intended for certain consumers and the price is high, which not all consumers can afford [4]. Variations of RTD Milk with certain functional properties have not dominated the consumer market yet, so it has a wide market opportunity [5]. Some functional food components include probiotics, bioactive peptides [6], essential fatty acids, antioxidants (including all pigments, flavonoids, catechins, various vitamins, minerals, etc.) [7], prebiotics (including non-structural carbohydrates, resistant starch, simple sugars such as XOS, FOS, GOS, xylose, sugar alcohols, etc.) [8]. Each of these functional components has certain functional properties that can improve human health if consumed continuously at the minimum recommended daily intake [9]. Prebiotics are functional components with the most amount in nature, ranging from simple sugars to non-structural carbohydrates sourced from plant and animal materials [10]. One of the abundant sources is xylose derived from lignocellulosic derivatives, the largest component of biomass on Earth [11], [12]. Lignocellulosic sources do not compete with the main food ingredients, so their availability is abundant [3]. Xylose has anti-diabetic properties by regulating the metabolism of sugar in the blood [13]. Xylose is a simple sugar that has a sweet taste with the same level of sweetness as sucrose (consumer sugar) so it is effectively used as a functional food in RTD milk [14].

Xylose is prebiotic, so RTD prebiotic milk that is added by xylose becomes RTD prebiotic candidate milk. Candidate words are added for functional products that have not been validated through repeated in-vivo tests [15]. The potential use of xylose as a sweetener in RTD milk, as well as a functional component, can increase the added value of the resulting RTD prebiotic candidate milk products [16], [17]. Product-added value is the product value that has increased as a result of the addition of a particular technology or process or material that can increase the selling value of the product. Calculation of the added value of a product needs to be done to provide an assessment of the projected sales profit of the product being planned [17] [16], [18], [19]. This is useful for owners of capital or policyholders in a company.

The prebiotic candidate RTD milk formulation will be applied at Tefa Milk Processing at the Jember State Polytechnic (Polije), so it is necessary to analyze the product's added value as a consideration in the application of this technology. Calculation of added value is carried out using the Hayami and Kawagoe methods. The product value-added assessment components that will be used as a basis for decision-making include added value, profit level, the share of labour, and profit margins. Various economic analysis calculations need to be carried out to avoid the wastage of resources due to incorrect production planning calculations.

The product formulation that is calculated as a reference for calculating product added value in this article is the result of previous research that has determined product formulation using the QFD method. The data used for calculations in this article are primary and secondary. Primary data is sourced from research results, while secondary data is obtained from interviews during the research implementation process. The product formulation that is calculated as a reference for calculating product added value in this article is the result of previous research that has determined product formulation using the QFD method. The data used for calculations in this article are primary and secondary. Primary data is sourced from research results, while secondary data is obtained from interviews during the research implementation process.

2 Method

Research activities were carried out at Tefa Milk Processing in the Polije area which is located at Jalan Mastrip 164 Sumbersari Jember 68101. The research was carried out in October - December 2022. The research was conducted using a descriptive method to explain the added-value analysis results calculation of RTD prebiotic candidate milk product. Calculations were performed using the Hayami and Kawagoe methods. Calculations are made using three price variations, namely prices when raw material costs and product prices decrease, normal, and increase. The instruments used in this study were the results of research on the development of RTD prebiotic candidate milk formulations and Microsoft Excel, Microsoft Word, and Microsoft Visio software. The data used in the research is primary data, namely data from direct observation during research on the development of product formulations. Data analysis was carried out in the form of tabulations with the help of the Microsoft Excel 2010 application. Data were analyzed to obtain product-added value. The amount of added value of the product is calculated so that the added value of pure milk is obtained to become RTD prebiotic candidate milk. The Hayami and Kawagoe method of added value analysis is an instrument that is often used for agricultural commodities. The treatments in this study were:

1. The added value of RTD prebiotic candidate milk products (RPM).
2. The added value of RTD Fresh milk (RFM) is without xylose addition as a prebiotic but with the addition of sucrose as a sweetener.

The two treatments were then compared to describe the difference in the added value of the resulting product. The responses observed in the study were a piece of information:

1. Added value, namely added value to commodities that have undergone processing, packaging, transportation, and storage so that they become a product to be marketed.
2. Margin that shows the contribution of the owner of factors of production other than the raw materials used in the production process.

The Hayami and Kawagoe added-value analysis calculation method formulation was described as follows [17].

1. Output (L/year) : a
2. Input (L/year) : b
3. Labour (Labour Day/year) : c
4. Conversion Factor : e = a/b
5. Labour Coefficient (Labour day/L) : f = c/b
6. Output Price (IDR/L) : g
7. Direct labour wage (IDR/Labour Day) : h

Acceptance and Profit

1. Raw material price (IDR/L)	: i	
2. Other input contribution (IDR/L)	: j	
3. Output value ((IDR/L)	: k	= e x g
4. Added value (IDR/L)	: l	= k - i - j
5. Added value ratio (%)	: m	= (l/k) x 100%
6. Direct labour income (IDR/L)	: n	= f x h
7. Labour share (%)	: o	= (n/l) x 100%
8. Profit (IDR/L)	: p	= l – n
9. profit rate (%)	: q	= (p/l) x 100%

Remuneration for the production factors owners

1. Margin (IDR/L)	: r = k – i
2. Labour income (%)	: s = (n/r) x 100%
3. other input contribution (%)	: t = (j/r) x 100%
4. company owner profit (%)	: u= (p/r) x 100%

3 Result and Discussion

Added value analysis which was done in this research analyzes the economic added value of RTD milk produced by Tefa Milk Processing of Polije. The economic added value of RTD milk is present as the value price due to the addition of functional value raw material and processing technology which has its superiority. Economic added value needs to be calculated to a determined decision in upscaling the production process [6]. The added value needs to be done to maintain customer satisfaction and retention, good revenue generation, reduce customer complaints, reach regulatory requirements or compliance, and keep a good reputation in the industry or brand protection [20]. This research calculates the economic added value of RTD candidate prebiotic milk and RTD fresh milk as its comparison of added value.

One cycle production batch is carried out for 3 hours so that 2 production batches can be carried out in one day. Total working hours in 1 day is 9 hours including rest and cleaning time. Working hours start at 07.00 and end at 16.00. The maximum capacity of one production batch is 1000L, in one production batch, the raw material for fresh milk used was 80% of the production capacity. This was done considering the addition of other ingredients. Each product is packaged in a sterile PET bottle with a net volume of 200mL. The differences between the two products being compared are the raw materials used and the final product obtained. The yield of RPM products is 125%, while the yield of RFM is 112.5%. Comparative conditions for the production of RTD dairy products compared to their added value are presented in Table 1.

The product formulations presented in Table 2 are used as the basis for determining the price of raw materials used in the calculation of the added value of the Hayami and Kawagoe methods. The price used in the calculation was divided into 3 classifications, namely price 1 for the price when the price was low in the market, price 2 for the normal price when the research was carried out, and price 3 for the price set as the highest retail price. Prices of raw materials used in the analysis are presented in Table 3.

Table 1. Production condition of RTD Milk in One Day (2 batch production)

Criteria	RTD Prebiotic Candidate Milk (RPM)	RTD Milk (RFM)
Product Formulation	Fresh milk 80% Xylose 8% Collagen 1.5% Skim milk 10% Other supplements ingredient 0.5%	Fresh milk 80% Sucrose 10% Skim Milk 10%
Production Capacity (L/day)	1,600	1,600
Product Output (L/day)	2,000	1,800
Product Output (bottle/day)	10,000	9,000
Working days/week	5	5
Labour (man)	10	10

Table 2. The Price of Raw Materials (2 production batches/day)

Raw Material	Needs/	Price (IDR/L or IDR/Kg)			Raw Material Price		
	day	1	2	3	1	2	3
Fresh milk (L)	1,280	7,000	8,000	9,000	8,960,000	10,240,000	11,520,000
Xylose (Kg)	128	90,000	100,000	120,000	11,520,000	12,800,000	15,360,000
Sucrose (Kg)	160	13,000	14,000	15,000	2,080,000	2,240,000	2,400,000
Collagen (Kg)	24	120,000	160,000	200,000	2,880,000	3,840,000	4,800,000
Skim milk (Kg)	160	60,000	70,000	80,000	9,600,000	11,200,000	12,800,000
others (Kg)	8	10,000	12,000	14,000	80,000	96,000	112,000
Total Price RPM					33,040,000	38,176,000	44,592,000
Total Price RFM					20,640,000	23,680,000	26,720,000

The production costs for the use of the equipment are assumed to be the same for the two product variants being compared. The difference between the two variants is only in the raw materials used to increase the added value of the resulting product. Another input contribution calculated in this research was: (a) packaging material and (b) utility (A variable consists of additional production machine cost and transportation production cost). The other input contribution cost is presented in Table 3.

Table 3. Other Input Contribution in One Day (2 batch production)

No	Other Input	Product Variance	Unit	Price/unit	Total Price
1	Bottle packaging	RPM	10,000	2,500	25,000,000
		RGM	9,000	2,500	22,500,000
2	Bottle label	RPM	10,000	200	2,000,000
		RGM	9,000	200	1,800,000
3	Utility	RPM	1	2,000,000	2,000,000
		RGM	1	2,000,000	2,000,000
Total Other Input Contribution Cost				RPM	29,000,000
				RFM	26,300,000

Prices for other input contributions are calculated based on actual prices calculated in the study. The amounts of bottles and packaging labels are calculated based on the number of products produced in one day of production (capacity of 2 batches/day). Utilities are calculated based on energy needs and public transportation required from the time the raw materials are received until the product is marketed. The Labor wages are labour wages according to government regulation number 78 of 2015 article 12. A recap of raw material prices, labour prices, labour requirements, and output prices is presented in Table 4.

Table 4. Raw material price and other input contribution in RTD Milk production of Tefa Milk Processing Polije in One day (2 production cycles)

In One Year (5 days of work x 4 weeks x 12 month = 240 days) One day = twice the production cycle		
Treatment	RPM	RFM
Raw Material (Fresh Milk) (L)	1,280	1,280
Output (RTD Milk) (L)	2,000	1,800
Labour (Man)	10	10
Days of Work (in one week)	5	5
Labour wage (man/day)	100,000	100,000
Price		
Raw Material		
Condition 1 (IDR)	33,040,000	20,640,000
Condition 2 (IDR)	38,176,000	23,680,000
Condition 3 (IDR)	44,592,000	26,720,000
Other Input Contribution (IDR)	29,000,000	26,300,000
Product Price (IDR)	10,000	6,000

Production capacity is calculated based on the amount of main raw materials (raw milk) used in 1 day of production, not based on all raw materials used in production (raw milk and auxiliary materials). This makes the number of workers, the number of working days, and the cost of labour wages can be equated between the product variance of RPM and RFM. Raw material prices are obtained from the calculation results in Table 2. Other input contribution prices are obtained from the calculation results in Table 3. The product price is obtained from the calculation of the cost of goods sold.

Based on the recap value of raw materials and other input contributions from Tables 2, 3, and 4, the analysis of the economic added value of RTD milk can be calculated using the Hayami and Kawago method (equation 1) and is presented in Table 5 for the economic added value of RPM (RTD prebiotic candidate Milk) and Table 6 for the economic added value of RFM (RTD Fresh Milk).

The outputs produced in raw milk processing in this study were RTD milk with variants of prebiotic candidate (RPM) and fresh milk (RFM). The RPM variant for one year produces an output of 480,000 L, while RFM produces an output of 432,000 L. The output calculation is obtained from the raw materials used per day multiplied by the number of active days of production. On average per month, milk processing Tefa can process 6,400 L of raw milk with an RPM yield of 125% and an RFM yield of

112.5%. The difference in yield was due to the different total dissolved solids in the two RTD milk variants. The calculated workforce is all workers who play a direct role in the RTD milk processing process. In processing this product, generally, 10 workers are needed with a working time of 10 hours/day. The number of working days (HOK) in RTD milk processing is 2,400 working days per year.

Table 5. The Economic Added Value of RTD prebiotic candidate Milk (RPM)

No	Parameter	RPM		
		Condition 1	Condition 2	Condition 3
1	Output (L/Year)	480,000	480,000	480,000
2	Raw Material (L/Year)	307,200	307,200	307,200
3	Labour (Labor Day/Year)	2400	2,400	2,400
4	Conversion Factor (output/input)	1.56	1.56	1.56
5	Labor Coefficient (Labor day/L) (4:3)	0.0007	0.0007	0.0007
6	Output Price (IDR/L)	50,000	50,000	50,000
7	Direct labour wage (IDR/Labor Day)	1,000,000	1,000,000	1,000,000
Acceptance and Profit				
9	Raw material price (IDR/L)	25,813	29,825	34,838
10	Other input contribution (IDR/L)	22,656	22,656	22,656
11	Output value ((IDR/L)	78,125	78,125	78,125
12	Added value (IDR/L)	29,656	25,644	20,631
	Added value ratio (%)	37.96%	32.82%	26.41%
13	Direct labour income (IDR/L)	651	651	651
	Labour share (%)	2.20%	2.54%	3.16%
14	Profit (IDR/L)	29,005	24,993	19,980
	profit rate (%)	97.80%	97.46%	96.84%
Remuneration for the production factors owners				
15	Margin (IDR/L)	52,313	48,300	43,288
	Labour income (%)	1.24%	1.35%	1.50%
	Other input contribution (%)	43.31%	46.91%	52.34%
	Company owner profit (%)	55.45%	51.74%	46.16%

Based on the calculation of added value in Tables 4 and 5, the conversion factor is obtained by dividing the number of outputs by the number of inputs. Based on the calculation, the RPM conversion factor is 1.56 for RPM or 1 for RFM, which means that every 1 L of raw milk will produce 1.56L RPM or 1L RFM. The labour coefficient is the division between labour work days/year) and raw materials (L/year) used in the production process. If each labour value is divided by the raw materials used, a labour coefficient value was obtained. A coefficient value of 0.0007 is obtained for RPM and 0.0004 for RFM, meaning that the processing of 10,000L of raw milk needs 7 labour or RPM production or 4 labour for RFM production. The need for labour or RTD milk processing is lower than planned, this is done to processing process speed up because there are processing processes that still use manual technology, done by humans, not machines.

The output value is obtained from the product price multiplied by the conversion factor, which is 78.125IDR/L for the RPM variant and 42.188IDR/L for the RFM variant, meaning that every 1 L of RTD milk production, it will produce 78.125IDR from the sales of the RPM variant or 42.188 IDR from the sales of RFM. The output value is equal to the gross labour receipt for every 1 litre of input used.

The added value generated from the RPM variant RTD milk production process is 25,664 IDR input or 3,141 IDR input for the RFM variant. The added value ratio is the ratio between added value and output value. In this study, the contribution of added value to the output value is 32.82% for the RPM variant and 7.44% for the RFM variant. The added value obtained is then calculated by its ratio to the output value of the product. The product-added value ratio shows the added value of the product resulting from the calculated value-added product. The RPM product output value is 78,125IDR/L so there is 32.82% of the added value of the RPM variant product. RFM products have an output value of 42,188IDR/L so there is a 7.44% added value of the product from its raw materials. Based on the results of Hayami's analysis, positive added value means that the development of RTD prebiotic candidate milk formulations can provide added value for business owners.

Table 6. The Economic Added Value of RTD Fresh Milk (RFM)

No	Parameter	RFM		
		Condition 1	Condition 2	Condition 3
1	Output (L/Year)	432,000	432,000	432,000
2	Raw Material (L/Year)	307,200	307,200	307,200
3	Labour (Labor Day/Year)	2400	2,400	2,400
4	Conversion Factor (output/input)	1	1	1
5	Labor Coefficient (Labour day/L) (4:3)	0.00	0.00	0.00
6	Output Price (IDR/L)	30,000	30,000	30,000
7	Direct labour wages (IDR/LaborDayy)	1,000,000	1,000,000	1,000,000
Acceptance and Profit				
9	Raw material price (IDR/L)	16,125	18,500	20,875
10	Other input contribution (IDR/L)	20,547	20,547	20,547
11	Output value ((IDR/L)	42,188	42,188	42,188
12	Added value (IDR/L)	5,516	3,141	766
	Added value ratio (%)	13.07%	7.44%	1.81%
13	Direct labour income (IDR/L)	586	586	586
	Labour share (%)	10.62%	18.66%	76.53%
14	Profit (IDR/L)	4,930	2,555	180
	profit rate (%)	89.38%	81.34%	23.47%
Remuneration for the production factors owners				
15	Margin (IDR/L)	26,063	23,688	21,313
	Labour income (%)	2.25%	2.47%	2.75%
	Other input contribution (%)	78.84%	86.74%	96.41%
	Company owner profit (%)	18.91%	10.78%	0.84%

Based on the observations in Tables 5 and 6 of the economic added value of the RPM and RFM treatment, it can be concluded that the economic added value is strongly influenced by raw materials, product yield, and prices resulting from raw materials composition differences [19] [16]–[18], [21]. The addition of raw materials or differences in the composition of the raw material can increase the product yield as well as the value of the products produced. The addition of raw materials or differences in the composition of raw materials can increase the yield of products and increase the value of the products produced. Adding product value can increase the selling value or product output value. This will contribute to an increase in added value, added value ratio, profit level, and profit for business owners. This will also reduce labour costs and other input contribution costs.

4 Conclusion

The study showed that the addition of xylose as a prebiotic affect the value-added of RTD milk produced. The raw material of RTD milk with xylose formulation was higher than the normal formulation without xylose addition, but the xylose addition increased its final product. The increase in final product volume could increase its raw material value-added. It was made more product could be sold and more profit could be taken. The value-added analysis results show raw milk processing into RTD prebiotic candidate milk could give value-added to milk until 25,644 IDR/kg with the value-added ratio of 32.82%., higher than Fresh milk processed without xylose formulation which has an added value of 3,141 IDR/kg with the value-added ratio of 7.44%. The profit earned ofromRTD milk with xylose formulation was 24,993 IDR/kg with a profit rate of 97.46%. Based on the added value and profit gained, the processing of raw milk into RTD prebiotic candidate milk is feasible to be developed because it provides benefits for business owners. The business owner's profit is 51.74% of the product sales profit.

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