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Оценка экономической эффективности внедрения процесса акустической заморозки в производстве замороженных блюд

РЕЗЮМЕ

Настоящая статья представляет собой оценку экономической эффективности внедрения акустической заморозки блюд. На основе исходных данных, таких как объем инвестиций, объем продукции и основные конкурентные преимущества рассматриваемой технологии, были рассчитаны основные экономические показатели. Доказано, что внедрение новой технологии позволит увеличить выручку организации за счет ее возможности повышать отпускные цены на замороженные полуфабрикаты с новыми качественными свойствами. Рентабельность новой производственной линии составила 11%. Срок окупаемости внедрения данного технического решения составит менее 2,5 лет. Доказано, что технология заморозки блюд с применением акустического воздействия экономически выгодна.

Ключевые слова: продукты питания, акустическая заморозка, рентабельность, срок окупаемости, замороженные блюда

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Evaluation of economic efficiency of introduction of the acoustic freezing process in the frozen meals production

ABSTRACT

The present article presents an evaluation of economic efficiency of the introduction of meals acoustic freezing. Based on the initial data, like the amount of investments, the volume of products and the main competitive advantages of the technology under consideration, the main economic indicators were calculated. It has been proved that the introduction of new technology will increase the organization's revenue due to its capability to increase the selling prices for frozen meals with new quality properties. The profitability of the new production line accounted for 11%. The payback period for implementation of this technical solution will be less than 2.5 years. It has been proved that the technology of meals freezing with application of acoustic effects is cost-effective.

Key words: foodstuffs, acoustic freezing, profitability, payback period, frozen meals production

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Введение / Introduction

The food industry is an essential and integral part of the state economy. The peculiar feature of this industry is the seasonality of raw materials harvesting and high risks related with the storage, processing and transportation of the raw materials and finished products, as well as their sale [1–6]. Therefore, the priority task for this industry is an introduction of technological solutions that allow extension of the storage periods for both agricultural raw materials and for the finished products [7–9] under mandatory condition – the products must comply with the requirements of international standards for food safety [10, 11]. One of these methods is acoustic freezing. Acoustic freezing is the freezing technology providing for the product freezing by the low temperatures and by acoustic waves at the same time. The acoustic waves create microscopic crystals in the depth of the product, which do not destroy the native structure of the product [12, 13].

The use of this technology will reduce production costs, increase the rational use of resources, help achieve higher economic indicators and, above all, will increase production efficiency.

Thus, it is advisable to evaluate the effectiveness of introduction of acoustic freezing technology in the food industry.

Материал и методы исследования / Materials and method

During the research, a range of indicators will be used, which are calculated using the following formulas:

Sales revenue:

$$B = V \times P, \tag{1}$$

where V – volume of the produced products;
P – price for the piece.

Cost of sales:

$$C_{sales} = SC_{total} + SC + R_{beg} - R_{end}, \tag{2}$$

where SC_{total} – total self-cost of the manufactured products,
SC – selling costs,
R_{beg} and R_{end} – remains of unsold finished products as of the beginning and the end of the accounting period.

Sales profit:

$$P_{sales} = \Pi_B - SC - AE, \tag{3}$$

where P_{gross} – gross profit;
SC – selling costs;
AE – administrative expenses.

Profit before tax:

$$P_{bt} = P_{sales} + I_{rec} - I_{pay} + OI - OE, \tag{4}$$

where P_{bt} – profit before tax;
P_{sales} – profit from sales;
I_{partic} – income from participation in other enterprises;
I_{rec} – interest receivable;
I_{pay} – interest payable;
OI and OE – other incomes and expenses.

Net profit (NP):

$$NP = REV - C_{sales} - AE - SE + OI - OE - IT, \tag{5}$$

where REV – revenue;
C_{sales} – cost of sales;
AE and SE – administrative and selling expenses;
OI and OE – other incomes and expenses.;
IT – income tax.

Return on assets (R_{as}):

$$R_{sa} = \frac{N_p}{S_a} \times 100\%, \tag{6}$$

where N_p – net profit;
S_a – sum of assets.

Return on production:

$$R_{pr} = Pr \div S_c \times 100, \tag{7}$$

where R_{pr} – return on production;
Pr – profit;
Sc – self-cost.

Return on sales (R_{sales}):

$$R_{sales} = \frac{P_{sales}}{REV} \times 100\%, \tag{8}$$

where P_{sales} – profit from sales;
REV – revenue from sales.

Net profit margin:

$$NPM = \frac{N_{profit}}{REV} \times 100, \tag{9}$$

where REV – revenue from sales;
N_{profit} – net profit.

Ratio of absolute liquidity (R_{al}):

$$R_{al} = \frac{MF + STFI}{CSTI}, \tag{10}$$

where MF – monetary funds, thousand rubles;
$STFI$ – short-term financial investments, thousand rubles;
$CSTI$ – current short-term indebtedness, thousand rubles.

Critical ratio of liquidity (CR_l):

$$CR_i = \frac{MF + STAR}{CSTI}, \tag{11}$$

where MF – monetary funds, thousand rubles;
$STAR$ – short-term accounts receivable up to 12 months, thousand rubles;
$CSTI$ – current short-term indebtedness, thousand rubles.
The recommended value for this indicator is not less than 1.

Ratio of current liquidity (R_{cl}):

$$R_{cl} = \frac{CA}{CSTI}, \tag{12}$$

where CA – current assets, thousand rubles;
$CSTI$ – current short-term indebtedness, thousand rubles.

Ratio of own sources coverage (R_{osc}):

$$R_{osc} = \frac{EC - NCA}{CA}, \tag{13}$$

where EC – equity capital, thousand rubles;
NCA – non-current assets, thousand rubles;
CA – circulating assets, thousand rubles.

The established norm value for this indicator is equal to 0.1.

Ratio of the enterprise autonomy (R_{eauton}):

$$R_{eauton} = \frac{EC}{CB}, \qquad (14)$$

where EC – equity capital, thousand rubles;
CB – currency of balance, thousand rubles.

Ratio of funding ($R_{funding}$):

$$R_{funding} = \frac{EC}{BF}, \qquad (15)$$

where EC – equity capital, thousand rubles;
BF – borrowed funds, thousand rubles.

Ratio of financial stability (R_{fs}):

$$R_{fs} = \frac{EC + LTBF}{CB}, \qquad (16)$$

where EC – equity capital, thousand rubles;
$LTBF$ – long-term borrowed funds, thousand rubles;
CB – currency of balance, thousand rubles.

Результаты и обсуждение / Results and discussion

The financial evaluation of the acoustic freezing introduction involves evaluation of development and installation additional equipment. The list of necessary equipment for completing the installation for acoustic freezing of meals includes 74 machinery items, with a total cost of 1 583 839 rubles.

In addition to the concurrent costs, it is necessary to determine the operating costs to keep the installation operable. The running costs include the coolant. The coolant of R404A type is used; its consumption is 3.6 kg. Electric power for technological needs is accounted through a separate article. Electric power consumption does not exceed 6.0 kW/h.

In addition technical maintenance of the technological unit is required. Technical maintenance requires two types of specialists: engineers and technicians, as well as IT specialist. Let's suppose the monthly surcharge for the additional volume of work is 5 thousand rubles. Also, the planned and unscheduled repairs of the acoustic freezing line will be required. The amount of additional costs for repair and maintenance of the installation will be set at 10% of the cost of basic and additional equipment. The total calculation of operational costs per 1 year of operation is 897 691 rubles.

One unit of equipment allows cooling and freezing 93 622.5 kg of meals per year, taking into account the downtime for scheduled repairs of the equipment.

Provided that meals acoustic freezing unit is loaded at a design level of 93 620 kg of meals per year, for the study period – 5 years – the cost of each kilogram of refrigerated and frozen meals will amount to 13.7 rubles.

However, this technology is distinguished by a number of advantages, such as: the organoleptic characteristics of acoustically frozen meals are higher; they feature longer shelf life and low weight loss during thawing.

So, having determined the mass of frozen meals, in our case – ready-made full meals at the level of 93 620 kg, and knowing the cost of production and the cost of selling this finished product – it is possible to determine how the production performance values will change during the considered period.

The planned economic indicators of the enterprise are presented in the Table 1 below.

The cost of production and sales will not increase at the same rate, and therefore the rate of gross revenue growth will exceed the rate of expenses growth. However, the prime cost will also increase due to inflation, as well as due to expenses for purchasing and maintaining the new equipment, which ensures the introduction of a new technology for freezing products using acoustic wave influences. Sales expenses and administrative expenses will increase gradually. The amount of net profit in the planned period increases.

These financial results will influence the indices of profitability. Let's calculate those indices that are influenced by the introduction of new technology (table 2).

The table data show increase of the profitability indices. The exception is the value of the profitability of sales and profitability of production in the year following the baseline date. This is explained by the fact that at this period it is technically necessary to introduce the process of freezing meals with application of acoustic waves. After a period of this technology introduction, all indices of performance begin to increase steadily.

Table 1. **Structure of profit and cost**

Index	Value, thousand rubles	Planned period				
Revenue (net) from the sale of goods, works and services	44 323	47 869	50 741	53 278	55 409	57 071
Cost of sales of goods, products, works and services	40 073	44 177	45 106	46 067	47 063	48 093
Gross profit	4250	3692	5635	7211	8347	8979
Business expenses	286	295	303	313	322	332
Administrative expenses	750	773	796	820	844	869
Profit (loss) from sales	3214	2625	4536	6079	7181	7778
Profit (loss) before tax	602	750	890	1031	1144	1255
Income tax	120	150	178	206	229	251
Net profit	481	600	712	825	915	1004

Table 2. **Forecasted values of profitability coefficients**

Coefficient	Periods	Meaning, %	Planned period				
Return on assets	By profit before tax	71.9	94.1	108.5	122.4	132.0	140.9
	By net profit	57.5	75.3	86.8	97.9	105.6	112.7
Return on sales	By profit from core activities	7.3	5.5	8.9	11.4	13.0	13.6
	By net profit	1.1	1.3	1.4	1.5	1.7	1.8
Production profitability	By profit from core activities	8.0	5.9	10.1	13.2	15.3	16.2
	By net profit	1.2	1.4	1.6	1.8	1.9	2.1

The analysis of resource turnover values is presented in table 3 below.

These values changed significantly due to the fact that introduction of new technology provides the new possibilities for storing of the finished products; so the accounting approach to formation of circulation funds in general and revolving funds in particular changes too.

The introduction of a new technology for freezing meals under acoustic waves will have a significant impact on efficiency of labor resources (table 4).

It is planned to increase the number of employees in the enterprise. This is explained by increase of production volumes in the enterprise. However, despite the increase in the number of personnel, the labor productivity increases throughout the study period. The profitability of the personnel also increases. The growth of this value means an increase in labor resources efficiency.

The analysis of the impact of the introduction of the technology of freezing meals with the use of acoustic effects on the economic efficiency of the organization as a whole showed an increase in indicators.

However, it is also necessary to determine the indicators of return on investment to the new technology. This rate of return can be calculated by determining the increment in the financial of the indicators of the enterprise performance, i.e. by increase of revenue obtained from the introduction of this technology (table 5).

The profitability of this enterprise was equal to 11%. The payback period for this technical solution will be less than 2.5 years.

Therefore the conducted analysis allows concluding that the technology of freezing the ready-made meals using acoustic effects is cost-effective.

Moreover, the evaluation of economic impact of introduction of the new technology of freezing meals by acoustic effects on the final financial performance of the enterprise is positive. The indicators of labor resources efficiency increased, the labor productivity of the enterprise personnel improved, the indicators of the turnover of working capital improved too. The system of the rate of return indices, which are considered the most comprehensive indicators for evaluation of efficiency, also showed significant growth.

Thus, the introduction of the technology of freezing meals by acoustic effects can be recommended for its practical application in the industrial enterprise.

Выводы / Conclusion

The introduction of new technology will increase the enterprise rate of revenue due to the technical capability to increase the selling prices for frozen meals of new quality.

The payback period of the new technology introduction was determined. This period can be calculated by determining the increments in the financial performance indices of the enterprise, i.e. through increase of revenue obtained from the introduction of the new technology.

The profitability index of this technological line accounted for 11%. The payback period for this technical solution will be less than 2.5 years. Therefore the conducted analysis allows concluding that the technology of freezing the ready-made meals using acoustic effects is cost-effective.

Table 3. **Planned values of assets turnover**

Index		Base period value	Planned period				
			1	2	3	4	5
Turnover ratio	Assets	61.39	58.60	62.75	64.08	64.84	64.94
	Current assets	73.26	63.12	62.79	64.12	64.84	64.94
	Circulation funds	189.01	127.31	119.22	121.91	123.46	123.82
	Revolving funds	111.09	113.06	118.52	120.83	122.00	122.00
	Finished products	547.20	319.13	328.42	334.80	338.05	338.05
Turnover duration	Assets	5.95	6.23	5.82	5.70	5.63	5.62
	Current assets	4.98	5.78	5.81	5.69	5.63	5.62
	Circulation funds	1.93	2.87	3.06	2.99	2.96	2.95
	Revolving funds	3.29	3.23	3.08	3.02	2.99	2.99
	Finished products	0.67	1.14	1.11	1.09	1.08	1.08

Table 4. **Forecasted values of labor productivity**

Index	Base period value	Planned period			
Average number of personnel, people	32	34	35	36	37
Labor productivity, thousand rubles / person	1385.09	1492.38	1522.23	1539.14	1542.47
Profitability of personnel, %	18.81	26.18	29.47	31.77	33.93

Table 5. **Evaluation of the efficiency of the installation for freezing meals using acoustic effects**

Years	1	2	3	4	5
Increase in proceeds from the sale of ready-made frozen meals using the new technology, rub.	1 123 470	1 157 735.8	1 193 047	1 229 435	1 266 932
Unit development and maintenance costs, rub.	1 599 430	897 691	929 110.2	961 629	995 286.1
Cumulative cash flow, rub.	−475 960	−215 915.2	48 021.43	315 827.1	587 473.5

РЕГИОНАЛЬНАЯ И ОТРАСЛЕВАЯ ЭКОНОМИКА

Moreover, the evaluation of economic impact of introduction of the new technology of freezing meals by acoustic effects on the final financial performance of the enterprise is positive.

Thus, the introduction of the technology of freezing meals by acoustic effects can be recommended for its practical application in the industrial enterprise.

Все авторы несут ответственность за свою работу и представленные данные.
Все авторы внесли равный вклад в эту научную работу.
Авторы в равной степени участвовали в написании рукописи и несут равную ответственность за плагиат.
Авторы заявляют об отсутствии конфликта интересов.

All authors bear responsibility for the work and presented data.

All authors have made an equal contribution to this scientific work.
The authors were equally involved in writing the manuscript and bear the equal responsibility for plagiarism.
The authors declare no conflict of interest.

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