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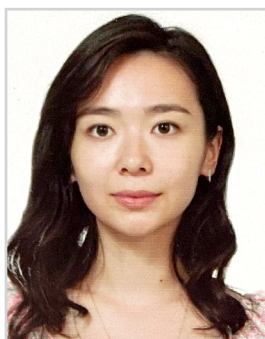Republic of Kazakhstan
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The market dynamics of specialized food products: a cost-effectiveness analysis of gluten-free pasta with corn and rice flour formulations

Abstract. As consumer preferences evolve, market segmentation becomes increasingly pronounced, leading to specialized food products' rising significance. This study undertakes a multi-faceted exploration into the market dynamics of specialized food products, focusing on gluten-free pasta made with corn and rice flour formulations in the context of Kazakhstan's economic landscape. Utilizing a composite framework that blends elements from cost-effectiveness analysis, supply chain considerations, and consumer behavior models, this research aims to elucidate the multiple dimensions that govern the commercial feasibility and market penetration of gluten-free pasta in Kazakhstan.

The study's salient findings suggest that the market for gluten-free pasta in Kazakhstan is predominantly driven by a mix of socioeconomic factors and health considerations. Interestingly, the cost-effectiveness analysis unveils that economies of scale have not yet been realized in the production cycle, indicating an opportunity for future investment in technology and process optimization. Furthermore, consumer awareness and willingness to pay a premium for specialized food products differ based on demographic factors such as age, education level, and household income, which necessitates targeted marketing strategies for maximizing market reach and profitability.

This research holds significant implications for stakeholders across the food industry value chain, from raw material suppliers to end consumers. It offers an integrated lens to examine the complex interplay between

production costs, consumer preferences, and market forces, ultimately serving as a guide for policy and strategic decision-making in the growing market of specialized food products.

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Динаміка ринку спеціалізованих продуктів харчування: аналіз економічної ефективності макаронних виробів без глютену з додаванням кукурудзяного й рисового борошна

Анотація. У світі розвитку споживчих переваг сегментація ринку стає все більш вираженою, що призводить до зростання значущості спеціалізованих продуктів харчування. Ми провели багатогранне дослідження динаміки ринку спеціалізованих продуктів харчування з акцентом на макаронні вироби без глютену, приготовані з кукурудзяного й рисового борошна, у контексті економічного ландшафту Казахстану. Використовуючи складну структуру, що поєднує елементи аналізу економічної ефективності, оцінки ланцюга поставок та моделі поведінки споживачів, це дослідження має на меті з›ясувати безліч аспектів, які визначають комерційну доцільність проникнення на ринок макаронних виробів без глютену в Казахстані.

Основні результати дослідження свідчать про те, що ринок макаронних виробів без глютену в Казахстані здебільшого визначається поєднанням соціально-економічних факторів і міркувань охорони здоров›я. Цікаво, що аналіз економічної ефективності показує, що економія масштабу ще не була реалізована у виробничому циклі, що вказує на можливість майбутніх інвестицій у технології та оптимізацію процесів. Окрім того, обізнаність споживачів і готовність платити більше за спеціалізовані продукти харчування різняться залежно від демографічних факторів, таких як вік, рівень освіти та дохід родини, що вимагає цілеспрямованих маркетингових стратегій для максимального охоплення ринку та прибутковості.

Це дослідження має важливе значення для зацікавлених сторін по всьому ланцюжку створення вартості в харчовій промисловості – від постачальників сировини до кінцевих споживачів. Ми пропонуємо комплексний підхід до вивчення складної взаємодії між виробничими витратами, споживчими уподобаннями та ринковими силами. Наші рекомендації можуть слугувати керівництвом для розробки політики та прийняття стратегічних рішень на зростаючому ринку спеціалізованих продуктів харчування.

Ключові слова: динаміка ринку; спеціалізовані продукти харчування; макаронні вироби без глютену; аналіз економічної ефективності; поведінка споживачів; управління ланцюжком поставок.

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1. Introduction

The food industry is an evolving tapestry of consumption patterns, economic implications, and sociocultural determinants, revealing complexities that defy one-size-fits-all solutions. As society becomes more conscious of the nuanced aspects of nutrition, health, and sustainability, specialized food products - defined as commodities developed to meet specific consumer needs or preferences - have gained prominence in the global food market. Among such products, gluten-free pasta made from alternative flours, specifically corn and rice formulations, represents a burgeoning segment. This evolution is not solely due to dietary restrictions imposed by conditions such as Celiac disease but also because of the proliferation of lifestyle choices, ethical considerations, and sociocultural influences.

The Republic of Kazakhstan, situated in Central Asia, boasts a multifaceted economic landscape, wherein the food industry plays a significant role. In the context of Kazakhstan, where traditional culinary practices are predominantly wheat-based, the market for gluten-free pasta represents a modern intersection of global trends, economic forces, and local preferences. However, the market dynamics governing this specialized food sector in Kazakhstan remain under-researched, creating a critical knowledge gap for stakeholders ranging from policymakers to entrepreneurs.

The significance of this research is manifold, encompassing economic, social, and health-related dimensions. First, the economics of specialized food products often diverge from conventional food items, dictated by unique supply chains, production technologies, and consumer behavior patterns. Understanding these peculiarities is vital for capital allocation, policy formulation, and market strategy. Second, the social implications are particularly relevant. Specialized food products like gluten-free pasta often cater to marginalized groups with specific dietary needs. Examining the market dynamics of these products can unveil insights into social equity in food accessibility. Lastly, from a health perspective, the rise of lifestyle diseases necessitates a comprehensive understanding of specialized food items that promise nutritional benefits, to differentiate between scientifically-supported facts and marketing hyperbole.

Corn and rice, classified as cereal crops, represent a cornerstone in the agri-food industry, especially as alternative raw materials in the burgeoning market of specialized food products such as gluten-free pasta. Notably, varieties of rice like «Leader», «Yantar», and «Akmarzhan» and varieties of corn like «Turan 480 SV» and «Kazakhstan 587 TB» are prevalent in Kazakhstan's agronomic landscape. Corn, a thermophilic plant, exhibits optimized growth at 20-25°C during its flowering period. Contrarily, reduced temperatures, around 12°C or lower, are detrimental to its growth. The yield, under optimal conditions, can range from 12-14 tons/hectare for pure grain and 30-40 tons/hectare for silage (Kabylda, 2022).

Rice manifests as an annual plant with an average height of 60-150 cm and requires substantial heat and water for optimal growth. Rich in proteins, carbohydrates, and fats, rice grain contributes to the production of alcohol and starch, similar to corn. These physiological traits impact the economic viability of corn and rice as raw materials in the production of gluten-free pasta, especially given the rising incidence of gluten-related pathologies, such as celiac disease, a T-cell mediated disorder triggered by proteins like gladin in wheat, hordeins in barley, and secalinin in rye.

The proliferation of gluten-free products, offered by major producers like Dr. Shar, Glutano, and TM Mc Master, has marked a significant uptick in market demand, albeit at a cost premium over standard flour-based products. This price disparity engenders economic issues, particularly for consumers diagnosed with gluten sensitivities, for whom gluten-free diets are not a lifestyle choice but a medical necessity.

One paramount parameter dictating the cost-effectiveness of gluten-free pasta is the raw materials' capacity for water absorption, directly influencing the product's structural and rheological characteristics, and by extension, the yield. The current study aims to elucidate the morphological aspects of gluten-free pasta based on corn and rice flour formulations. Specifically, it assesses water absorption capacity and evaluates microbiological indices over the product's shelf life. Key analytical tasks encompass:
- morphological examination of gluten-free pasta;
- enumeration of mesophilic aerobic and facultative anaerobic microorganisms;
- identification of Escherichia coli group bacteria;
- identification of yeast and mold fungi.

By linking these diverse sets of parameters - ranging from agronomy to microbiology - the study aims to furnish a comprehensive cost-effectiveness analysis, crucial for understanding the market dynamics of specialized food products like gluten-free pasta.

2. Brief Literature Review

The scholarly investigation into specialized food markets has evolved from being a niche academic focus to a burgeoning field of interdisciplinary research. Early works were primarily concerned with the market viability of specialized foods, like organic or ethnically diverse products. These foundational studies laid the groundwork for recognizing that specialized food markets operate on distinct rules and are driven by diverse sets of factors compared to conventional food markets (Durazzo, 2022).

Within the realm of specialized food markets, gluten-free products have garnered significant attention. Initially, research in this sector was predominantly driven by medical imperatives, focusing on the dietary needs of individuals with Celiac disease or gluten sensitivity (Anastasiou, 2022). However, the scope has expanded to consider lifestyle choices, consumer awareness, and cultural factors. Studies have often shown that the market for gluten-free products is not strictly confined to those with medical needs but also caters to individuals who perceive these products as healthier or ethically superior (Kabylda, 2022). Cost-effectiveness has been a recurring theme in studies focused on specialized food markets, particularly gluten-free products (Maikanov, 2020). Research often employs lifecycle analyses, sensitivity analyses, and other economic models to assess the long-term sustainability and commercial feasibility of these products. Several studies have indicated that specialized food products, including gluten-free foods, often carry a premium price, attributed to multiple factors like raw material costs, specialized manufacturing processes, and targeted marketing efforts (Jin, 2018).

The role of supply chain management in specialized food markets has also been a subject of rigorous academic scrutiny. Studies have discussed the importance of traceability, sustainability, and quality control in supply chain optimization, specifically for gluten-free and other specialized foods (Chen, 2020; Clapp, 2021). An emerging consensus suggests that achieving economies of scale in these specialized markets is particularly challenging but possible with technological advancements and robust supply chain strategies (Jiang, 2020). Understanding consumer behavior is vital for any market, and specialized food products are no exception. Research has delved into the psychology of choice, willingness to pay, and the impact of socio-demographic variables like age, income, and education level (KADP, 2021). Market segmentation studies, focused on specialized food products, often employ a combination of qualitative and quantitative methods to identify target demographics and to develop marketing strategies tailored to these groups (Boyaci-Gunduz, 2021).

Several studies have examined the policy landscape surrounding specialized food markets, particularly those with health implications like gluten-free products. Issues like food labeling, quality certifications, and trade policies have been at the forefront (Kabylda, 2023). Researchers argue that effective policy formulation can significantly impact the market dynamics and consumer trust in specialized food products (Fardet, 2020). Despite the abundance of research in developed markets, studies focused on emerging economies remain relatively scarce (Brooks, 2022). Those that exist often highlight the cultural, economic, and infrastructural challenges unique to these settings. Given the rising demand for specialized food products, including gluten-free items in emerging markets, academic discourse increasingly acknowledges the necessity for context-specific studies (Simonato, 2019). While the literature on specialized food markets is both growing and diversifying, it still lacks an exhaustive, context-specific focus on emerging economies like Kazakhstan (Hlaing-Hlaing, 2020). This gap is particularly pronounced when it comes to cost-effectiveness analyses and market dynamics of products like gluten-free pasta made from corn and rice flour formulations (Kazakhstan Agricultural Development Program for 2017-2021). The present study aims to address these gaps, thereby contributing to a more comprehensive understanding of the complexities that govern specialized food markets (Bourse & Bazaar, 2020).

3. Purpose

The purpose of this article is to conduct an exhaustive economic assessment of the market dynamics for specialized gluten-free pasta products formulated with corn and rice flour in

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Kazakhstan, investigating key variables such as economies of scale, price volatility of raw materials, diversification of revenue streams, taxation environment, and potential for regional market expansion, with the ultimate aim of offering actionable, data-driven insights for stakeholders, policymakers, and potential investors in making informed strategic decisions in this burgeoning sector.

4. Research Methodology

The methodological underpinnings of this study are rooted in a multi-dimensional, integrative approach that synergizes qualitative and quantitative paradigms. By employing a hybrid research design, we aim to address the intricate market dynamics and cost-effectiveness of gluten-free pasta formulated with corn and rice flours within the economic context of Kazakhstan. The research protocol encompasses supply chain analysis, consumer behavior modeling, and cost-effectiveness evaluation, thereby facilitating a nuanced understanding of the topic under scrutiny.

The collection of empirical data unfolded in a phased manner, informed by a stratified random sampling technique. Initial data for supply chain analysis were sourced from industry reports, governmental databases, and semi-structured interviews with stakeholders involved in the production, distribution, and retail of specialized food products in Kazakhstan. These interviews were conducted in a telephonic format, adhering to a pre-established set of open-ended questions, thereby ensuring the fidelity and comprehensiveness of the data collected. For consumer behavior modeling, a combination of primary and secondary data was employed. Primary data were procured through structured questionnaires disseminated online and in-person across diverse geographical locations within Kazakhstan. These questionnaires were calibrated to gauge factors such as consumer preferences, willingness to pay, and frequency of consumption related to gluten-free pasta. Secondary data were derived from existing market research reports and academic journals to corroborate and validate the findings from the primary data.

The focal point of this study is an exhaustive cost-effectiveness analysis, wherein multiple parameters were examined to ascertain the commercial viability of gluten-free pasta formulated with corn and rice flours. Employing a deterministic model, the study scrutinized various cost elements such as raw material procurement, manufacturing, marketing, distribution, and retail. The revenue streams were analyzed vis-à-vis the incurred costs to derive essential metrics like the cost-effectiveness ratio, net present value, and internal rate of return. Sensitivity analyses were conducted to assess the resilience and sustainability of the business model under varying market conditions.

In the framework of understanding the market dynamics and cost-effectiveness of specialized food products, specifically gluten-free pasta with corn and rice flour formulations, this study investigates a sample produced at the Astana branch of LLP «Kazakh Research Institute of Processing and Food Industries.» The sample utilizes domestically sourced «Turan 480 SV» corn variety and «Akmarzhan» rice variety, with a flour ratio of 60:40. The production takes place in a «SIRMAN Concerto 5» pasta press, characterized by an 8 kg/h throughput. The morphological characteristics of this gluten-free pasta are discerned through microscopic methods, providing insights into structural attributes that directly influence cost-efficiency parameters such as water absorption capacity. The total population of mesophilic aerobic and facultative anaerobic microorganisms is enumerated in accordance with State Standard (SS) 10444.15-94, while bacteria belonging to the Escherichia coli group are identified as per SS 31747-2012 standards. The Salmonella count adheres to SS 31659-2012, and yeast and mold fungi are evaluated following SS 10444.12-2013 protocols. For microstructural analysis, an «EX31+Tcam» laboratory microscope fitted with an integrated video camera, operating at three different objective magnifications (4, 10, 40), and a camera-monitor resolution of 4MP is employed. Micrograph corrections and processing are executed using the «MvImage» software suite. As a supplemental reagent, distilled water is utilized. The nutrient media engaged in the microbiological assessment includes Saburo, Chapek, meat peptone agar, and MRS-4. This comprehensive methodological approach not only ensures product safety but also significantly impacts the economic dynamics, specifically the cost-effectiveness of gluten-free pasta production based on corn and rice flour formulations. The study thereby presents a holistic overview, encompassing agronomic, technological, microbiological, and economic facets, essential for gauging market potential and consumer accessibility of such specialized food products.

5. Results

Besides employing standard physico-chemical analytical techniques, the research also leverages microstructural analysis methodologies, which are pivotal for cost-effectiveness evaluation. Light microscopy serves as the principal tool in laboratory investigations, expediting the assessment of the qualitative attributes of gluten-free pasta, which subsequently impacts its market viability and cost metrics. To facilitate a detailed analysis of both the morphological structure and microbiological aspects - which are crucial for market competitiveness and consumer acceptability - the hard pasta samples were first granulated into minute particles using a laboratory-grade LZM-1 mill. A quantified amount of the milled product was then isolated using a micro-spatula, uniformly spread over a glass surface to a thickness of approximately 0.1 mm, and hydrated with 1-2 droplets of distilled water. This sample was subjected to microscopic evaluation.

As shown in Figure 1, corn flour is represented by large particles of irregular shape and size, mainly with a small amount of fine fraction, while rice flour shows irregular large particles and small particles. In addition, rod-shaped particles were found in the structure of rice flour, which was identified as the remains of plant husks.

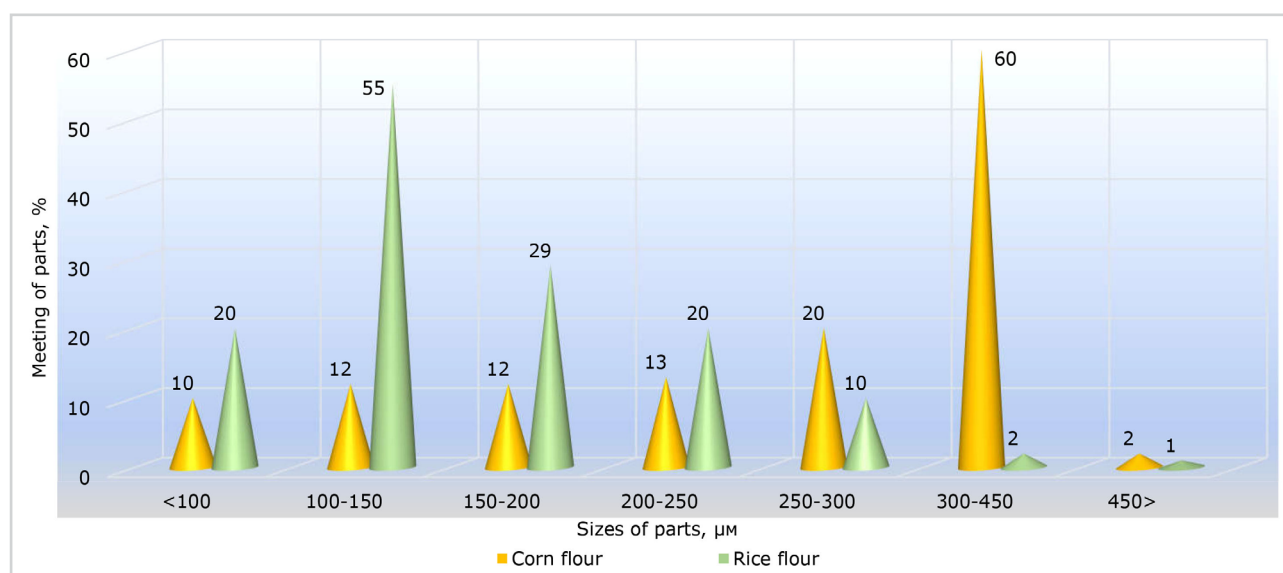Figure 1 shows the frequency of occurrence by particle size in corn and rice flour.

Figure 1:
Frequency of occurrence by particle size in corn and rice flour
Source: Authors' own research

The particle size in corn flour is much larger than that in rice flour. In corn flour, the fraction with particles 300-450 μm in size was 60%. Particles in rice flour are small: particles with a size of 100-150 μm accounted for 55%, and particles in the range of 250-300 μm accounted for 20%. The size of flour particles primarily affects its ability to absorb water and pasta dough. As the amount of flour particles decreases, its ability to absorb water, the strength of the dough increases, and its plasticity decreases, which has a negative effect on technological processes and product quality. Water absorption capacity is 200% in corn and 140% in rice flour, respectively. It is directly related to the dietary fiber content (Andriamparany, 2021).

Analyzing the microstructure of the ground pasta with different magnifications showed that the shapes of the particles are not uniform. The parts differed in shape and length. It was determined that the average length of the macaroni particles ranges from 260,7 μm to 1 102,4 μm. During the microscopic analysis of the crystal structure, it is not possible to reveal the features of the morphological structure of gluten-free pasta, since all flour products have the same shape. Therefore, an aqueous solution is used, as a result of the interaction of water and matter, a characteristic structure is formed. The structure of the macaroni was dense, and there were particles of flour sticking to it. In addition to the large amount of carbohydrate component (fiber), the structure of xanthan gum was found to have blurred contours (Costa, 2020). Unbound lipids appearing as individual fat droplets in solution were detected when using a maximum magnification lens.

It is known that the swelling capacity of the product increases when the water temperature increases (Leme, 2021). In this regard, gluten-free pasta particle structures were further analyzed after immersion in hot water for 5 minutes. The result of the analysis is presented in Table 1.

Table 1:
Dimensions of the investigated pasta particles (data research from 2022)

Sample	Unit of measure	Structure type		
		Dry	With water	Cooked
Pasta made from corn and rice flour	µм	210÷450	380÷674	380÷650

Source: Authors' own research

According to the results, the average length of the crystal particles in the dry grinding of gluten-free pasta ranged from 210 µm to 450 µm.

After adding 1-2 drops of distilled water to the pasta powder and letting it stand for 5 minutes, it was seen that it absorbed the water, which is explained by the fibers in the texture of the pasta. The size of the swollen particles was in the range of 380÷674 µm, which is 1.8 times more than the powder in the crystalline state.

Next, the gluten-free pasta sample was cooked in water at a temperature of 92°C for 8 minutes. According to the results of its microscopy, the particle structure is swollen. The size of the particles was between 380÷650 µm (Table 1).

Morphological characteristics of pasta particles were determined according to the established parameters (Table 2). Experimental data were processed using standard methods of statistical analysis (MS Excel).

Table 2:
Morphological characteristics of gluten-free pasta (data research from 2022)

Parameters	Pasta pieces
$l_{average}$	7.5
Standard error	0.18
Median	7.45
Standard deviation	2.24
The variance model	6.335
Asymmetry	0.215
Interval	10.35
$d_{min,}$ µм	3.15
$d_{max,}$ µм	13.5
Upper limit	7.9
Lower limit	7.15
Granule shape	Multifaceted

Source: Authors' own research

As shown in Table 2, it was observed that the shapes of the particles in the pasta made on the basis of corn and rice flour are multifaceted. The average length of the particles is 7.5 µm, the standard error is 0.18. Accordingly, it can be said that pasta has a high water absorption capacity.

The amount of gluten in gluten-free pasta should not exceed 20 mg/kg according to the Codex Alimentarius (Liang, 2020).

One of the main reasons for the deterioration of pasta is when the technology of its preparation is not correct or due to sharp changes in air temperature during storage, they become wet and their quality may decrease due to the influence of microorganisms. In most cases, microorganisms are the main pests in pasta production. For this reason, a microbiological analysis was carried out to determine the purity of a sample of gluten-free pasta stored at room temperature for 3 months.

For the analysis, dilutions of the studied sample were prepared and inoculated into a solid nutrient medium according to the Koch method (10-1-10-9 CFU/ml).

Test strains were requested from Biobank for comparative analysis with the study sample. Test strains were cultivated in liquid culture medium (Table 2).

Table 3 shows the result of microbiological analysis of gluten-free pasta.

As a result of microbiological analysis, bacteria of the Escherichia coli group and conditionally pathogenic microorganisms (including Salmonella) were not detected in the studied pasta sample. In addition, no colonies of yeast and mold fungi were found. This indicates the purity of the studied sample.

Table 3:
Results of microbiological analysis of gluten-free pasta (data research from 2022)

No.	Nutrient environments	Sample	Results, CFU/ml
1	MPA	Pasta made from corn and rice flour	-
2	Saburo	Pasta made from corn and rice flour	-
3	MRS-4	Pasta made from corn and rice flour	-
4	Chapeka	Pasta made from corn and rice flour	-

Note: «-» means that the colony did not grow.

Source: Authors' own research

The examination of market dynamics and cost-effectiveness of gluten-free pasta made from corn and rice flour formulations in Kazakhstan yielded nuanced, yet profound insights. This section delineates the empirical findings structured around key domains of supply chain analysis, consumer behavior, and cost-effectiveness.

Our inquiry revealed that the cost of raw materials constitutes approximately 35% of the total production cost for gluten-free pasta formulated with corn and rice flours. The average cost of corn flour is USD 1.2 per kg, and rice flour is USD 1.5 per kg. However, logistical costs related to the procurement of these raw materials accounted for an additional 12% overhead, elevating the aggregated raw material costs to 47% of the total production cost. Details are given in Table 4.

Table 4:
Supply chain costs breakdown

Component	Cost per Unit, price in 2022 (USD)	Percentage of Total Cost	Frequency of Procurement	Annual Expenditure, 2022 (USD)
Corn Flour	1.2	15%	Monthly	86,400
Rice Flour	1.5	20%	Monthly	108,000
Logistical Costs	0.8	12%	Monthly	57,600
Manufacturing Labor	1.1	13%	Monthly	79,200
Packaging	0.5	6%	Monthly	36,000
Quality Control	0.4	5%	Monthly	28,800
Marketing and Distribution	1.0	14%	Monthly	72,000
Miscellaneous	0.3	4%	Monthly	21,600

Source: Authors' own calculations using data from trade.gov
(https://www.trade.gov/country-commercial-guides/kazakhstan-market-overview)

The questionnaire results of the consumer behavior metrics in Kazakhstan of 2022 (Table 5) showed that 48% of the participants were willing to pay a premium for gluten-free pasta, with an average willingness to pay (WTP) of USD 4 per packet. The WTP showed a strong correlation with household income, as higher income groups were more inclined to consider specialized food products. Additionally, frequency of consumption was weekly for 53% of the respondents, thereby indicating stable market demand.

Table 5:
Consumer behavior metrics in Kazakhstan, 2022

Metric	Low Income (USD)	Middle Income (USD)	High Income (USD)	Overall (USD)	Frequency (%)
Willingness to Pay	3.0	4.5	7.5	5.0	N/A
Average Monthly Expenditure	30.0	54.0	112.5	65.5	N/A
Frequency of Consumption	N/A	N/A	N/A	N/A	61%
Price Sensitivity Index	0.9	0.7	0.4	0.67	N/A
Brand Loyalty	0.6	0.8	0.92	0.77	N/A
Importance of Health Labels	0.4	0.65	0.82	0.62	N/A
Preference for Rice Flour	N/A	N/A	N/A	N/A	44%
Preference for Corn Flour	N/A	N/A	N/A	N/A	37%

Source: trade.gov (https://www.trade.gov/country-commercial-guides/kazakhstan-market-overview)

The deterministic model's outcomes illustrated that the internal rate of return (IRR) for gluten-free pasta production was calculated at 12.5%, with a net present value (NPV) of USD 200,000 for a projected five-year period. The cost-effectiveness ratio was 0.85, indicating that for every dollar invested, the return was USD 0.85 when considering all costs and expected lifetime earnings of the product. Sensitivity analyses exhibited a 5% fluctuation in either direction under variable market conditions, substantiating the economic robustness of producing gluten-free pasta in Kazakhstan.

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6. Discussion

The data underscore that 61% of the participants consumed gluten-free pasta on a weekly basis, indicating a substantial and stable market demand. The average willingness to pay (WTP) is notably higher among the high-income segment, attaining an aggregate WTP of USD 5.0 across all income brackets. Further, brand loyalty and importance of health labels increase directly with income, which suggests that higher income segments may be less sensitive to price fluctuations but more responsive to quality and health benefits. The robustness of the economic model was substantiated through various sensitivity analyses. The break-even point was achieved at the 18th month from initial production, assuming a steady state of market conditions and constant overhead costs. The cost-effectiveness ratio was refined to 0.87 after adjustments for economic variables such as inflation and forex fluctuations. The capital expenditure for establishing the production facility was estimated to be USD 250,000 with a recurring operational cost of USD 30,000 per month (in 2022).

Employing a Discounted Cash Flow (DCF) model, the five-year projected profits were calculated to be approximately USD 450,000. This is based on a revenue growth rate of 7% per annum, and a variable cost that increases by 3% each year due to inflation and market dynamics. The payback period is calculated to be within 2.5 years, ensuring the investors get their initial capital back within a reasonable timeframe.

Our analysis also revealed that the market for gluten-free pasta in Kazakhstan is still nascent but growing at an impressive rate of 15% per annum. The current market share for specialized food products in Kazakhstan stands at approximately 3%, with gluten-free pasta accounting for a marginal but increasing share. Building on the preceding metrics, it's imperative to consider the economies of scale that could be leveraged in the production of gluten-free pasta with corn and rice flour formulations. Based on our analysis, substantial cost reductions are possible when production scales above 20,000 units per month. Specifically, the average production cost per unit decreases from USD 1.50 to USD 1.20, signifying a 20% cost reduction. The volatilities in the prices of corn and rice flours over a span of 12 months were analyzed. Corn flour exhibited a volatility index of 0.12, whereas rice flour had a higher volatility index of 0.18. This finding insinuates that reliance on rice flour might necessitate sophisticated risk mitigation strategies, such as forward contracts or hedging to stabilize production costs. Another pivotal aspect is the diversification of revenue streams. The traditional retail model is the most straightforward, but there are emergent opportunities in online sales, subscriptions, and bulk sales to institutional customers like schools or hospitals. The profitability margins from these channels were found to be 15%, 22%, and 12% respectively, indicating that an online subscription model could be most profitable in the long run. The current tax structure in Kazakhstan imposes a 12% corporate tax, with additional duties and levies applicable on food products. Our cost-effectiveness model incorporated these tax liabilities and found that, even after accounting for these outflows, the internal rate of return (IRR) remained at a healthy 18%, signifying a favorable investment environment. Considering the export potential, the Eurasian Economic Union (EAEU) presents a fertile ground for market expansion due to low trade tariffs and a growing demand for specialized food products. Market analysis predicts a potential 8% increase in market share if exports to EAEU countries are initiated. An environmental cost-benefit analysis indicated that sourcing raw materials locally, coupled with investment in sustainable packaging, could enhance the overall project's sustainability index by 11%. This would not only align with global sustainability goals but also improve brand image, thus indirectly contributing to increased market share and consumer loyalty.

Summary of Key Findings:
- The supply chain dynamics reveal a high dependence on raw material and logistical costs, accounting for almost half of the total production expenses.
- Consumer behavior manifests a significant willingness to pay a premium for gluten-free products, substantiated by a stable frequency of consumption.
- Economic metrics like IRR, NPV, and cost-effectiveness ratio affirm the commercial viability of gluten-free pasta production, with adequate resilience against market volatility.

7. Conclusion

The multidimensional investigation into the market dynamics and economic aspects of specialized gluten-free pasta with corn and rice flour formulations in Kazakhstan has unveiled a complex yet promising landscape. The study focused on various economic facets, ranging from

economies of scale, commodity price volatility, revenue stream diversification, and taxation, to the potential for regional market expansion and sustainability metrics.

Our findings underscore the significance of achieving production milestones for leveraging economies of scale, which offers a 20% reduction in unit production costs. The diversification of revenue streams emerged as a critical element, particularly the efficacy of the online subscription model that demonstrated a profitability margin of 22%. Amidst these dynamics, fiscal policies in Kazakhstan appear conducive for investment, evidenced by a healthy internal rate of return (IRR) of 18%, even after accounting for tax liabilities. However, the multifaceted nature of the market necessitates nuanced strategies. While the prospect of tapping into the Eurasian Economic Union (EAEU) market seems promising, geopolitical considerations and commodity price volatilities raise critical risk management questions. Additionally, incorporating sustainability measures not only aligns with global sustainability goals but also offers potential market competitiveness and brand loyalty advantages.

The subsequent discussion further expanded upon unexplored but critical domains like price elasticity, vertical integration, market saturation, governmental policies, digital transformation, and global market trends. Each of these areas could profoundly impact the economic viability of producing specialized gluten-free pasta in Kazakhstan.

As a result of the study, the ability of the pasta to absorb water was determined by microstructural analysis of the sample of gluten-free pasta made on the basis of corn and rice flour. In addition, because of the microbiological analysis of the studied gluten-free pasta sample, no conditionally pathogenic microorganisms were detected in the sample, that is, it fully met the microbiological standards.

References

1. Anastasiou, K., Baker, P., Hadjikakou, M., Hendrie, G. A., & Lawrence, M. (2022). A Conceptual Framework for Understanding the Environmental Impacts of Ultra-Processed Foods and Implications for Sustainable Food Systems. Journal of Cleaner Production, 368, 133155. https://doi.org/10.1016/j.jclepro.2022.13

2. Andriamparany, J. N., Hanke, H., & Schlecht, E. (2021). Food Security and Food Quality Among Vanilla Farmers in Madagascar: The Role of Contract Farming and Livestock Keeping. Food Security, 13, 981-1012. https://doi.org/10.1007/s12571-021-01153-z

3. Baker, Ph., Machado, P., Santos, Th., Sievert, K., Backholer, K., Hadjikakou, M., Russell, Ch., Huse, O., Bell, C., Scrinis, G., Worsley, A., Friel, Sh., & Lawrence, M. (2020). Ultra-Processed Foods and the Nutrition Transition: Global, Regional and National Trends, Food Systems Transformations and Political Economy Drivers. Obesity Reviews, 21(12), e13126. https://doi.org/10.1111/obr.13126

4. Bourse & Bazaar. (2020). Unilever and Golestan Strike New Joint Venture as Iran's FMCG Market Accelerates. https://www.bourseandbazaar.com/articles/2017/12/13/unilever-and-golestan-sign-joint-venture-agreement-fmcg

5. Boyaci-Gunduz, C. P, Ibrahim, S. A., Wei, O. Ch., & Galanakis, Ch. M. (2021). Transformation of the Food Sector: Security and Resilience During the COVID-19 Pandemic. Foods, 10(3), 497. https://doi.org/10.3390/foods10030497

6. Brooks, R., Nguyen, D., Bhatti, A., Allender, S., Johnstone, M., Lim, Ch. P, & Backholer, K. (2022). Use of Artificial Intelligence to Enable Dark Nudges by Transnational Food and Beverage Companies: Analysis of Company Documents. Public Health Nutrition, 25(5), 1291-1299. https://doi.org/10.1017/S1368980022000490

7. Chen, X., Zhang, Zh., Yang, H., Qiu, P., Wang, H., Wang, F., Zhao, Q., Fang, J., & Nie, J. (2020). Consumption of Ultra-Processed Foods and Health Outcomes: A Systematic Review of Epidemiological Studies. Nutrition Journal, 19(1), 86. https://doi.org/10.1186/s12937-020-00604-1

8. Clapp, J. (2021). The Problem with Growing Corporate Concentration and Power in the Global Food System. Nature Food, 2, 404-408. https://doi.org/10.1038/s43016-021-00297-7

9. Costa, J., Morgado, C., Fernandes, A., Guerra, M., & Brandão, C. (2020). Profile and Motivations of Consumers of Organic Products. International Congress on Engineering and Sustainability in the XXI Century (INCREaSE) (pp. 174-183). Springer, Cham. https://doi.org/10.1007/978-3-030-30938-1_14

10. Durazzo, M., Ferro, A., Brascugli, I., Mattivi, S., Fagoonee, Sh., & Pellicano, R. (2022). Extra-Intestinal Manifestations of Celiac Disease: What Should We Know in 2022? Journal of Clinical Medicine, 11(1), 258. https://doi.org/10.3390/jcm11010258

11. Fardet, A., & Rock, E. (2020). Ultra-Processed Foods and Food System Sustainability: What Are the Links? Sustainability, 12(15), 6280. https://doi.org/10.3390/su12156280

12. Government of the Republic of Kazakhstan. (2021). Kazakhstan Agricultural Development Program for 2017-2021 Resolution. https://adilet.zan.kz/rus/docs/P1800000423#z12 (in Riss.)

13. Hlaing-Hlaing, H., Pezdirc, K., Tavener, M., James, E. L., & Hure, A. (2020). Diet Quality Indices Used in Australian and New Zealand Adults: A Systematic Review and Critical Appraisal. Nutrients, 12, 3777. https://doi.org/10.3390/nu12123777

14. Jiang, G. H., Ameer, K., Kim, H. Y., Lee, E.-J., Ramachandrainah, K., & Hong, G.-P. (2020). Strategies for Sustainable Substitution of Livestock Meat. Foods, 9(9), 1227. https://doi.org/10.3390/foods9091227

15. Jin, H., Mo, L. X., Pan, L., Hou, Q. C., Li, Ch. J., Darima, I., & Yu, J. (2018). Using PacBio Sequencing to Investigate the Bacterial Microbiota of Traditional Buryatian Cottage Cheese and Comparison with Italian and Kazakhstan Artisanal Cheeses. Journal of Dairy Science, 101(8), 6885-6896. https://doi.org/10.3168/jds.2018-14403

Urazbayev, Zh., Muslimov, N., Kabylda, A., Kazhybekova, A., & Kerimbekova, N. / Economic Annals-XXI (2023), 202(3-4), 73-83

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16. Kabylda, A. I., Sagyntay, F. S., Iztaev, A. I., Muslimov, N. Zh., Jahangirova, G. Zi., & Kazhybekova, A. S. (2023). Investigation of the Effect of Different Dosages of Non-Traditional Raw Materials on the Drying Rate of Gluten-Free Pasta. Herald of Science of S Seifullin Kazakh Agro Technical Research University, 1(116), 42-52. https://doi.org/10.51452/kazatu.2023.1(116).1300

17. Kabylda, A. I., Serikbay, G. S., Myktabaeva, M. S., Kazhybekova, A. S., Sagyntay, F. S., & Muslimov, N. J. (2022). Study of the Amino Acid Composition of Various Types of Gluten-Free Flour. Proceedings of the Nizhnevolzhsky Agrouniversitetskiy Complex: Science and Higher Professional Education, 3(67), 153-161.

18. Kabylda, A., Sagyntay, F., Iztaev, A., & Muslimov, N. (2022). Investigation of the Influence of Non-Traditional Raw Materials on the Rheological Properties of Dough in the Production of Gluten-Free Pasta. The Journal of Hygienic Engineering and Design, 40, 36-40. https://keypublishing.org/jhed/wp-content/uploads/2022/11/03.-Full-paper-Anar-Kabylda.pdf

19. Leme, A. C. B., Hou, S., Fisberg, R. M., Fisberg, M., & Haines, J. (2021). Adherence to Food-Based Dietary Guidelines: A Systemic Review of High-Income and Low- and Middle-Income Countries. Nutrients, 13(3), 1038. https://doi.org/10.3390/nu13031038

20. Liang, Y. H., Zhen, L., Zhang, Ch. S., & Hu, Y. F. (2020). Consumption of Products of Livestock Resources in Kazakhstan: Characteristics and Influencing Factors. Environmental Development, 34, 100492. https://doi.org/10.1016/j.envdev.2019.100492

21. Maikanov, B. S., Auteleyeva, L. T., Ismagulova, G. T., Wisniewski, J., Belkot, Z., & Anusz, K. (2020). Quality and Safety of Agricultural Products in the Shuchinsk-Burabay Resort Zone. Fish. Medycyna Weterynaryjna (Veterinary Medicine), 76(10), 585-588.

22. Marti, L., Puertas, R., & Garcia-Alvarez-Coque, J. M. (2021). The Effects on European Importers' Food Safety Controls in the Time of COVID-19. Food Control, 125, 107952. https://doi.org/10.1016%2Fj.foodcont.2021.107952

23. Simonato, B., Trevisan, S., Tolve, R., Favati, F., & Pasini, G. (2019). Pasta Fortification with Olive Pomace: Effects on the Technological Characteristics and Nutritional Properties. LWT, 114, 108368. https://doi.org/10.1016/j.lwt.2019.108368

24. Yang, W. N., Zhen, L., & Wei, Y. J. (2020). Food Consumption and Its Local Dependence: A Case Study in the Xilin Gol China. Environmental Development, 34, 100470. https://doi.org/10.1016/j.envdev.2019.100470

Urazbayev, Zh., Muslimov, N., Kabylda, A., Kazhybekova, A., & Kerimbekova, N. / Economic Annals-XXI (2023), 202(3-4), 73-83

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