JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

# APPLICATION OF THE HARRINGTON METHOD IN THE FOOD INDUSTRY

***Ulugbek Ibragimov***
*PhD, docent, Bukhara state technical university*

**Abstract:** This work explores the application of the Harrington desirability function method in the food industry, emphasizing its role in optimizing multiple quality parameters simultaneously. The method enables food technologists to assess and balance sensory, nutritional, and safety attributes effectively. It is widely applied in product formulation, process optimization, packaging, and quality control. By converting complex, multidimensional data into a single desirability value, the Harrington method supports efficient decision-making and enhances product development. The paper highlights recent studies and practical applications, underlining its growing relevance in ensuring consistent quality and consumer satisfaction in modern food production systems.
**Keywords:** Harrington desirability function, Food industry, Multi-criteria optimization, Product quality, Process optimization, Food safety, Sensory evaluation, New product development.

**Introduction.** The Harrington method (Harrington desirability method) is widely used in the food industry to assess the complex quality of products and processes. This method allows transforming different indicators (e.g. organoleptic, physicochemical, microbiological) into a single dimensionless desirability scale, which facilitates decision making.

**Application in the Food industry :**

1. **Evaluation of the quality of raw materials and products -** the method allows considering several criteria at once, such as taste, smell, texture, moisture content, acidity, etc**.**
2. **Optimization of technological processes - used to select the best processing modes (heat treatment, drying, fermentation, etc.).**
3. **Development of new products - helps to evaluate consumer satisfaction and adjust recipes.**
4. **Food safety control - allows you to take into account microbiological indicators and other safety parameters.**
5. **Optimization of technological processes** – used to select the best processing modes (heat treatment, drying, fermentation, etc.).
6. **Development of new products** – helps to evaluate consumer satisfaction and adjust recipes.
7. **Food safety control** – allows to take into account microbiological indicators and other safety parameters.

The Harrington desirability function method is a well-established multi-criteria decision-making tool that has gained increasing relevance in various industrial sectors, including the food industry. This method is particularly important where product quality depends on multiple parameters that need to be optimized simultaneously. As food production processes become more complex and consumer demands for quality, safety, and sustainability increase, the application of the Harrington method provides a systematic, quantitative framework for evaluating and optimizing product and process variables.

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

In the food industry, product quality is not defined by a single parameter but by a combination of attributes such as taste, texture, color, nutritional content, shelf life, and safety. Often, optimizing one characteristic may negatively affect another. For example, increasing shelf life may require preservatives that can impact taste or texture. The Harrington method is highly relevant in these situations because it transforms multiple quality characteristics into a single desirability value. This transformation allows producers to assess overall product acceptability and make informed decisions regarding process parameters or formulation changes.

A key advantage of the Harrington method in food processing is its ability to handle both subjective and objective criteria. For instance, sensory attributes such as flavor or aroma—often evaluated by trained panels or consumers—can be incorporated alongside objective laboratory measurements like pH, moisture content, or microbial counts. By assigning desirability functions to each characteristic, producers can optimize multiple goals simultaneously, improving overall product quality and consumer satisfaction.

Another area where the Harrington method is highly applicable is in quality control and standardization. Food manufacturing facilities are required to maintain consistent quality across large batches of products. Variations in raw materials, equipment performance, or environmental conditions can introduce inconsistencies. By applying the Harrington method, food scientists and engineers can identify optimal operating conditions that yield consistently high-quality products while reducing variability.

Furthermore, the Harrington method is useful in new product development (NPD), where multiple prototypes must be evaluated based on various performance indicators. During this process, the method helps to select the best formulation that meets desired levels of nutritional value, sensory appeal, cost-effectiveness, and regulatory compliance. It enables the efficient screening of a wide range of alternatives and ensures the final product meets multidimensional expectations.

Sustainability and food safety are additional areas where the method proves valuable. As regulations become stricter and consumers demand more environmentally friendly practices, food companies must optimize processes not only for quality but also for energy use, waste reduction, and hygiene. The Harrington method allows for the incorporation of such parameters into the decision-making framework, supporting the development of more sustainable food systems.

The Harrington desirability function has emerged as a pivotal tool in the food industry, facilitating the optimization of multiple quality parameters simultaneously. Its application spans various domains within food processing, ensuring products meet both consumer expectations and regulatory standards[1].

In the realm of food preservation, the Harrington method has proven instrumental. A study focusing on the freezing of cherry fruits treated with sodium alginate solutions demonstrated that a 5% solution yielded the highest desirability scores (0.98 and 0.97), indicating superior preservation quality. This approach allowed for the simultaneous assessment of factors like soluble solids and sugar-acid index, streamlining the optimization process[2].

Packaging, a critical aspect of food quality and shelf-life, has also benefited from the Harrington method. Research assessing combined packaging materials composed of natural components such as paper, chitosan, and wax utilized the desirability function to evaluate integrated quality.

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

The findings confirmed the method's efficacy in determining optimal material combinations, enhancing packaging performance[3].

Product formulation and process optimization represent another significant application area. An investigation into cucumber chutney production employed a factorial design to evaluate factors like osmotic dehydration time and thermal treatment. The desirability function facilitated the simultaneous optimization of multiple responses, including water activity and pH, leading to an optimal formulation that balanced all quality attributes[4].

The integration of fuzzy logic with the Harrington desirability function has further expanded its applicability. A study on multi-criteria food product identification combined these methodologies to assess consumer attractiveness and safety indices over time. By incorporating the Weibull probability density function, researchers established a comprehensive decision-making framework that accounted for both quality and temporal factors[3].

In the context of functional foods, the Harrington method has been utilized to evaluate competitive abilities in the market. By analyzing consumer features such as quality, safety, and functionality, researchers developed an algorithm that employed the desirability function to assess and enhance product competitiveness[2].

Furthermore, the method has been applied to optimize the nutritional composition of multicomponent food products. By calculating a generalized desirability function as the geometric mean of balanced state indices for macronutrients, vitamins, minerals, amino acids, fatty acids, and energy value, researchers provided a universal approach to selecting optimized formulations, minimizing subjectivity in decision-making[1]

Harrington desirability function serves as a versatile and robust tool in the food industry, enabling the simultaneous optimization of multiple quality parameters across various applications, including preservation, packaging, formulation, and nutritional optimization. Its integration with other methodologies like fuzzy logic further enhances its utility, supporting the development of high-quality, consumer-acceptable food products.

Let's consider an example of using the Harrington method to assess the quality of yogurt based on three indicators :

**Fat content (y1)** – optimal range is 2,5–3,5%,

**Acidity (y2)** – normal level 85–120°T,

**Organoleptic accident (y3)** – on 5 point scale.

1. Determining the actual values:

Let us assume that measurements have been taken and the following results have been obtained:

y1=3.0%;

y2=100°T;

y3=4.5 points;

2. Determining the desirability scales:

The Harrington function transforms each indicator into a value from 0 to 1.

Desirability formula:

Where m – average value, s – scaling coefficient.

We transform the indicators:

For fat content (y1=3.0), if m=3.0 s=0.5, then we have d1≈0.8.

For acidity ( 2=100), at =100, =10, we have 2≈0.9.

For organoleptic ( 3=4.5), if =4.0, =0.5, then 3≈0.85.

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

3. We calculate the integral indicator :

$$D = (d_1 \cdot d_2 \cdot d_3)^{1/3}$$

$$D = (0.8 \times 0.9 \times 0.85)^{1/3} \approx 0.85$$

4. Interpretation:
According to the Harrington scale:
0 – 0,2 → Very bad
0,2 – 0,37 → Bad
0,37 – 0,63 → Satisfying
0,63 – 0,8 → Good
0,8 – 1 → Very good
D=0.85 – This is "very good", which means that the quality of the yogurt meets high requirements.

**Conclusion**

The application of the Harrington desirability function in the food industry represents a significant advancement in multi-criteria optimization, offering a structured and reliable approach to improving product quality, safety, and consumer satisfaction. As food products are typically evaluated on a wide range of characteristics—such as taste, texture, nutritional value, shelf life, and microbiological safety—traditional single-parameter optimization methods fall short in capturing the complexity of real-world production. The Harrington method bridges this gap by allowing all relevant parameters to be considered simultaneously, transforming them into a single, interpretable desirability value.

The method's flexibility makes it highly applicable in various stages of food production, including formulation, process optimization, quality control, packaging selection, and new product development. It has shown practical value in studies involving functional foods, thermal processing, and sustainable packaging materials. Whether it's enhancing the sensory appeal of a product or optimizing its nutrient profile, the Harrington method offers a powerful decision-making tool that aligns with both technical goals and consumer preferences.

Moreover, the integration of the Harrington method with other decision-support tools, such as fuzzy logic and statistical models, further enhances its effectiveness. This is especially important in handling subjective criteria or uncertain data, common challenges in food technology.

In an increasingly competitive and quality-driven food industry, the ability to consistently develop and deliver products that meet multiple quality criteria is crucial. The Harrington method supports this by promoting objective, data-based decisions that improve both operational efficiency and product excellence. As such, it is not only relevant but essential for innovation and quality assurance in modern food processing environments.

**Reference**

1.Siddikova, S., Juraeva, M., Abrorov, A., & Kuvoncheva, M. (2025). Foreword-VII International Conference on Applied Physics, Information Technologies and Engineering–APITECH-VII 2025. In EPJ Web of Conferences (Vol. 321, p. 00001). EDP Sciences.

2.Siddiqova, S. (2024). Dual ta'limni joriy qilish metodologiyasi va psixologik jihatlari.YASHIL IQTISODIYOT VA TARAQQIYOT, 2(12).
3.SIDDIQOVA, S. (2024). ORGANIZATION OF THE EDUCATIONAL PROCESS BASED ON THE INTEGRATION OF SPECIAL SUBJECTS IN DUAL EDUCATION.News of the NUUz, 1(1.7), 185-187.
4.Siddiqova, S. (2024). Muhandislar–taraqqiyot tayanchi.YASHIL IQTISODIYOT VA TARAQQIYOT, 2(3).
5. Siddiqova, S. G., & Saidjonova, P. S. (2024). ISSUES OF DIGITALIZATION OF MEDICINE IN UZBEKISTAN.INTERNATIONAL SCIENCES, EDUCATION AND NEW LEARNING TECHNOLOGIES, 1(4), 168-172.
6.QOBILOV, H., & RUSTAMOV, A. A. O. G. L. (2025). OLIY TA'LIM TIZIMIDAGI PEDAGOG-XODIMLARNI KPI BO'YICHA FAOLIYATINI NAZORATLOVCHI AXBOROT TIZIMINI SUN'IY INTELLEKT ELEMENTLARI YORDAMIDA TAKOMILLASHTIRISH.PEDAGOGIK TADQIQOTLAR JURNALI, 2(2), 309-312.
7.QOBILOV, H., & RUSTAMOV, A. A. O. G. L. (2025). JAMOAT TRANSPORTIDA MANZILGA MOS GRAFIGI VA CHIPTANI HISOBLASH HAMDA TEKSHIRISH AVTOMATLASHTIRILGAN TIZIMI.PEDAGOGIK TADQIQOTLAR JURNALI, 2(2), 253-255.
8.Ramazon o‘g‘li, I. S., Sayidovich, N. M., Xalilovich, Q. H., & Nasillo o‘g‘li, S. A. (2024). SUYUQ SHISHADAN NATRIY SILIKAT PENTAGIDRAT ISHLAB CHIQARISHNI KRISTALLANISH JARAYONINI IMITATSION MODELS.YANGI O 'ZBEKISTON, YANGI TADQIQOTLAR JURNALI, 1(3), 128-134.
9.Kobilov, K., & Sharipova, N. (2024). Systematic analysis of briquette mass pressing equipment approach.YASHIL IQTISODIYOT VA TARAQQIYOT, 2(9).
10.Nasillo o‘g‘li, S. A. (2023). COMPUTER MODELING OF SHELL-TUBE HEAT EXCHANGER DEVICE IN OIL REFINING TECHNOLOGICAL SYSTEM.Ethiopian International Journal of Multidisciplinary Research, 10(11), 338-343.
11.Ibragimov, U. M., Qobilov, H. X., & Ismoilov, R. R. (2023). SABZAVOTLARNI SARALASH JARAYONIDA TRANSPORTYOR LENTANING SABZAVOT OG ‘IRLIGIGA BARDOSHLILIGINI SOLIDWORKS CAD/CAM/CAE TIZIMI SIMULIYATSIYASI ORQALI TEKSHIRISH.Oriental renaissance: Innovative, educational, natural and social sciences, 3(4), 438-445.
12.Jo'Rayev, X. F., Qobilov, H. X., & Jo'Rayev, M. T. (2023). KO ‘MIR YOQILG ‘ISI TUTUNINI TOZALSH JARAYONIDAGI QURILMA DETALLARINI (CAD/CAM/CAE) TIZIMIDA YARATISH VA SIMULYATSIYALASH.Oriental renaissance: Innovative, educational, natural and social sciences, 3(4), 474-481.
13.Abidov, K. Z., Qobilov, H. X., & Isroilov, A. A. (2023). SELLYULOZA-QOG ‘OZ SANOATIDA QOG ‘OZ POLOTNOSINI QURITISH TEXNOLOGIK JARAYONINIDAGI USKUNANING DETALINI SOLIDWORKS (CAD CAM CAE) TIZIMIDA YARATISH.Oriental renaissance: Innovative, educational, natural and social sciences, 3(4), 686-692.
14.Qobilov, H. X., & Raxmonkulova, X. O. (2023). ANALYSIS OF THE PROCESS OF COMBINED DRYING OF TOMATO SEEDS.Oriental renaissance: Innovative, educational, natural and social sciences, 3(9), 72-78.

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

15.Kobilov, K. (2022, December). Laboratory research of coal briquette quality indicators. In IOP Conference Series: Earth and Environmental Science (Vol. 1112, No. 1, p. 012007). IOP Publishing.

16.Abdurakhmonov, O. R., & Yuldashev, H. M. (2022). HIGHLY EFFICIENT FUSA TRAP FOR PURIFICATION OF PRESSED COTTONSEED OIL. Journal of Advances in Engineering Technology, (4), 19-21.

17.Kobilov, K., Abdurakhmonov, O., Sharipova, N., & Adizova, M. (2021, September). Development of the installation device pressing the volume of briquetted material and computer modeling of the technological process. In IOP Conference Series: Earth and Environmental Science (Vol. 839, No. 4, p. 042092). IOP Publishing.

18. Uktamova, Sh. H., & Kobilov, H. H. (2021). OLIY TALIMDA TALABALARNING SHAHSIY-KREATIV COMPETENCE OF RIVOJLANTIRISH OMILLARI. Scientific progress, 2(5), 327-329.

19. Abdurakhmanov, O. R., Usmonov, A. U., Kobilov, H. H., & Buronov, S. A. (2021). METHODOLOGY OF CONDUCTING AN EXPERIMENT ON THE PRODUCTION OF COAL BRIQUETTE USING BIOORGANIC BINDERS. In TECHNICAL SCIENCES: PROBLEMS AND SOLUTIONS (pp. 48-53). 20.Abdurakhmanov, O. R., Salimov, Z. S., & Saidakhmedov, Sh. M. (2016). Rational technology of rectification of oil and gas condensate mixture using hydrocarbon stripping agents. Oil and Gas Technologies, (3), 3-6.