AUTOMATION OF EXPERIMENTAL RESEARCH

MEAT QUALITY RESEARCH USING CLASSIFICATION ALGORITHMS

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Abstract. The food industry is going through constant improvements and is subject to analyzing consumer needs, product quality research is essential to striking this balance. In this regard, meat quality, the most essential food category, should be studied with unbiased methods that give precise and correct results. Classification algorithms are considered one of the main components of developing an objective and reliable method of meat quality assessment. Such algorithms imply meat analysis and classification automation with many parameters in mind, which eventually gives a chance to make quick and correct decisions concerning its quality.

Key words: Meat quality assessment, classification algorithms, machine learning, classification

1. Introduction

Meat is a valuable and essential source of protein and rare nutrients, and meat quality is becoming increasingly important for consumers. Evaluating meat quality is crucial in ensuring consumers access high-quality products. However, relying on subjective methodologies prone to human influence can lead to unreliable results. Therefore, adopting objective methodologies free from any human bias is necessary.

Food quality control methods are now an essential element for consumers worldwide. These methods are based on various approaches to ensure food safety and quality. The primary analysis methods are microbiological, physicochemical, and organoleptic. Let us take a closer look at the proposed methods:

- Microbiological analysis covers the analysis of the level of bacteria, molds, and other microorganisms in meat. This method aims to determine the level of microorganisms in meat, such as bacteria and fungi, which can affect the safety and quality of the product. The main objectives of microbiological analysis are to identify potentially hazardous microorganisms, determine the total amount of microflora, and conduct antibiotic resistance tests [1 - 3]. Specialized laboratories employ specific equipment and techniques to cultivate microorganisms for these analyses. Microbiological analysis requires microbiological environments for growing bacteria, incubators to provide optimal conditions for their growth, and microscopes and other tools to determine the types and number of microorganisms in meat samples.
- The physical and chemical method is a scientific approach that evaluates meat quality by measuring its physical and chemical characteristics. This method involves analyzing various parameters such as moisture, protein and fat content, amino acid composition, pH level, and others, which are essential in determining the quality and safety of meat [1, 4]. Specialized laboratories analyze meat properties using various scientific and technical instruments and equipment. To measure moisture content, precise scales or balances are used. Chromatography analyzes the amino acid composition, while pH meters determine pH levels [5]. The Kjeldahl or Dumas method measures the content of protein in meat [6].
- The organoleptic analysis relies on human senses like sight, taste, and smell. Meat color indicates freshness, with less shine on the surface indicating a less fresh product [4]. Tactile analysis helps assess consistency, softness, and texture. Meat should feel tender, seamless, and smooth. A foul odor indicates poor quality and determines whether it can be consumed [7].

2. Drawbacks

The big obstacle of meat quality research faces seems to be the choice of the most rapid and advanced technique of meat assessment. Consumers possess diverse senses and ideas, so their attitudes toward products are determined by a combination of factors: flavor, aroma, and texture. This method makes meat quality evaluation less objective and accurate.

In contrast, physical, chemical, and microbiological techniques analyze meat's chemical characteristics and microorganisms to confirm its quality. Regardless, these techniques are not effective since they require specific equipment that can be costly, and working conditions that are not commonly available. Sample preparation and analysis require qualified professionals and can be time-consuming.

3. Goal

The aim is based on the possible application of different assessment methods, and the development of algorithms for meat quality evaluation.

4. The meat quality assessment methods and the possibility of using classification algorithms

Let us conduct a comparative analysis of three main methods of meat quality: organoleptic, physical & chemical, and microbiological. The parameters to be compared include objectivity, resource requirements, usability, result detail, efficiency, and accessibility. The comparison results are presented in Table.

In summary, employing organoleptic, physical & chemical, and microbiological techniques presents alternative technologies, each with unique strengths and limitations. The organoleptic method may come to light because of its uncomplicated nature and straightforwardness; however, it is subjective. The physical & chemical method is objective. Nevertheless, this means that these methods need time and resources. The microbiological method gives exact values for the meat contamination level, but extensive time and labor are required for the procedure.

Table. Comparative analysis of meat quality assessment methods

Parameter	Organoleptic method	Physicochemical method	Microbiological method
Objectivity	Subjective, depending on the personal impressions and preferences of the appraiser.	Objective, the results are based on measurements of the physical and chemical parameters of meat.	Objective, allows you to objectively determine the level of microorganisms in meat.
Resource requirements	Low cost, does not require specialized equipment or chemicals.	High, requiring specialized equipment and chemicals	High, requiring specialized equipment and qualified personnel
Complexity.	Simple, and does not require special skills to conduct.	Complex, may require specialized knowledge and skills.	Complex, requiring specialized knowledge and skills to perform the analysis correctly.
Detailing the results	Low, results may be less detailed due to the subjective nature of perception.	High, provides detailed information on the chemical composition of meat.	High, allows for a detailed assessment of the level of contamination of meat with microorganisms.
Efficiency	High, can be carried out very quickly.	Low, can take a long time.	Low, it can take a long time to hold.
Availability	High, accessible to all.	Low, may not be available due to the need for specialized equipment and knowledge.	Low, may not be accessible to everyone due to the large amount of resources required for the event.

Implementing machine learning methods offers a significant potential to optimize the assessment of meat quality. Utilizing these techniques can considerably improve the subjective evaluation of meat quality, leading to a more precise and dependable organoleptic analysis process. The organoleptic method is a simpler and faster way to evaluate products from a consumer's perspective. However, it is subjective as the failure criterion is based on individual perception, and the standard by which criteria are compared can vary significantly among individuals [7]. Statistics show that more than 66% of people use the Internet. The overall number of users is 5.35 billion; 96% of those accessing the Internet through smartphones [8]. The emergence of these users is a unique chance to implement the algorithms of such systems in the world today. Assessing meat quality with

a smartphone camera offers enhanced convenience and accessibility for consumers. Moreover, the automated standardization process ensures reliable and consistent results. The method involving organoleptic analysis could make a technological breakthrough in the large-scale application of the method and increase consumer satisfaction in the differentiation of the meat quality product.

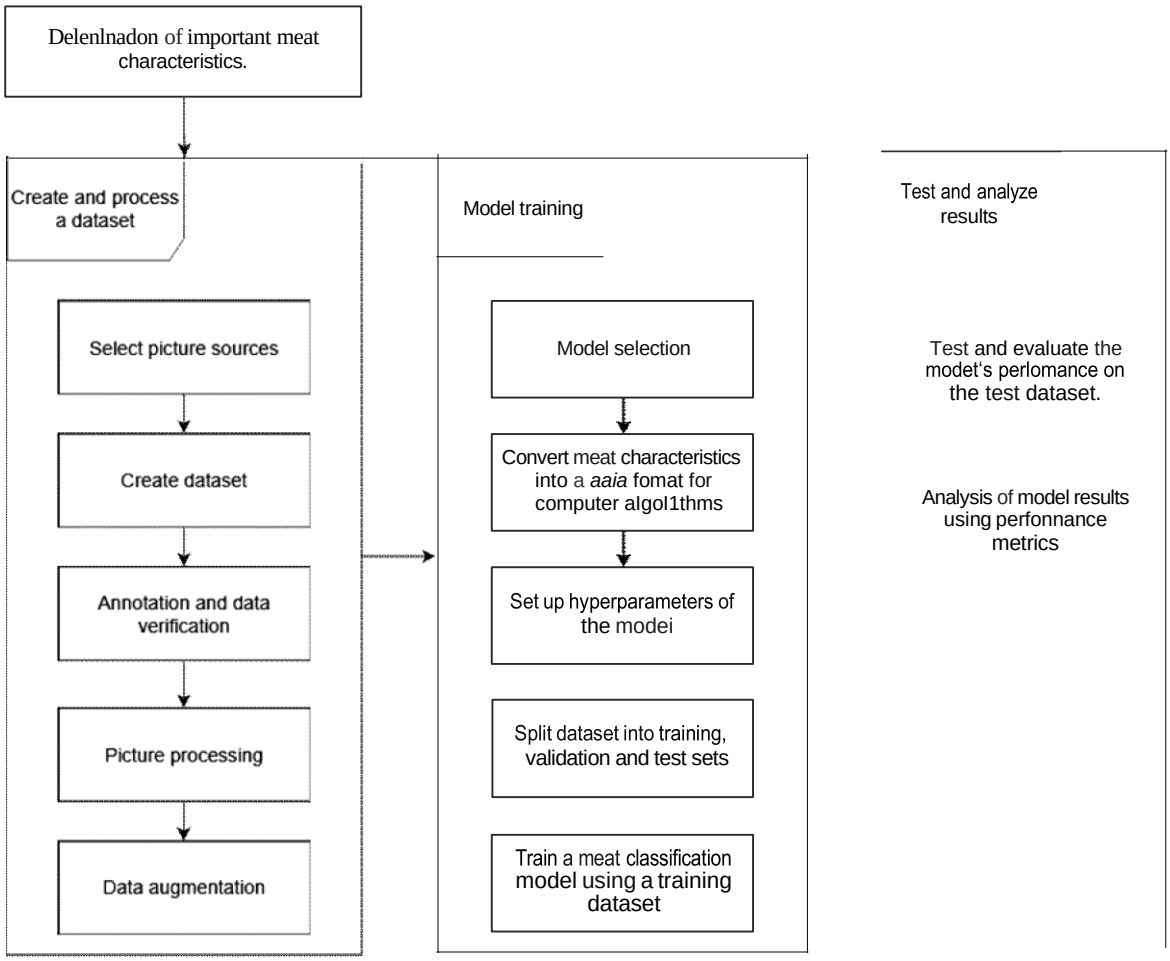
5. Meat quality assessment based on the classification algorithms

Our primary experience in the recent issue is the next and demonstrated in Fig.

Classification is the process of dividing every element of an input data set into one or more categories based on its composition. The aim is to design a model capable of categorizing new elements without the need for input data from previous training. Classification algorithms are related to the machine learning algorithms [9-10]. They derive from information-less data preprocessed into input variables and labels and learn the underlying structure of data to create a model that can classify new data. Accurately classifying meat quality relies on identifying the key attributes that determine its ranking.

The next crucial step is to gather a set of images. This can include images from online sources like image repositories, restaurant and shop webpages, and personal photographs. Next obtained data is required to verify the accuracy and preciseness. The final data set is then split into the train, validation, and test subsets for training and evaluating the model.

Performing specific processing and preprocessing tasks is essential when training a model. These tasks may include image reduction, brightness, and contrast normalization. Sometimes, it is necessary to utilize data augmentation techniques to improve model performance. Data augmentation involves creating additional data examples by applying various operations to existing images [11]. The considered technique is beneficial for deep learning models, as it expands the amount and variety of data while training. The processed data set must be formatted to be suitable for model training. The quality and efficiency of training models depend on how we create and process the data correctly.



Classification algorithms in meat quality assessment

The ensuing course of action is to decide on the suit- ability of the classification considering a given amount of data. Also, one needs to be apprehensive concerning com- puter power for optimal durability of selecting a model since particular algorithms, while applying deep neural networks, involve complex layers and nodes [12].

Model training is a crucial step in the process. It in- volves optimizing the model's parameters by inputting the training data. During this process, the model learns to pick out certain data features and recognize the essential structures of meat. Following the considered phase, the model should be put to operate trying to test and assess its performance. Here, it is vital to understand how perfectly the model has completed its duty and can pass on generalized knowledge to new data.

After running tests, the model's performance is evaluated using different characteristics, such as accuracy, sensitivity, specificity, and others [13]. Analyzing them, we provide information about the model's performance and gain insights into how the model's efficacy varies while altering types of meat, etc. This information helps to determine the reliability of the model and its potential applicabil- ity in other research areas related to meat.

The process described in Figure 1 shows how to de- velop, change, and alter the classification algorithms aiming to improve meat quality evaluation. Each step is crucial for obtaining accurate and reliable results.

Specialized mobile applications that leverage smart- phone cameras to evaluate meat quality have the potential to enhance the method's convenience and accessibility. By empowering consumers to make informed choices, such apps can help consumers make better purchase decisions.

6. Conclusions

Developing the classification algorithms of well- known methods of meat quality assessment, including organoleptic, physical & chemical, and microbiological methods can substantially improve the parameters of the evaluation, enhancing the quality of meat products. To bolster food quality and safety, the potential can be realized by optimization of classification algorithms enhancing accuracy and other metrological parameters.

7. Conflict of Interest

The authors state that this work has no financial or other potential conflicts.

8. Gratitude

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