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# Neutrosophic Iadov technique for assessing the proposal of standardization of the beef cutting for roasting in Patate canton, Ecuador

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**Abstract.** Meat is an important food for human consumption. Its consumption is associated with economic development, so that the more meat consumed, the higher the level of quality of life or index of wealth attributed to a population. This consideration has led, during the second half of the 20th century, to a greater consumption of meat. To prepare different dishes requires an adequate knowledge of cutting meat, so ignoring this aspect would be contradictory with gastronomy. In Ecuador, and particularly in the Patate canton, there is a lack of knowledge about the types of cuts that can be made with meat, in order to obtain favorable, appealing results and, in turn, make culinary art an art of excellence and quality. The objective of this work is to analyze the real situation of the knowledge of cutting meat, for a gastronomy of excellence and quality. To validate the results of the analysis that is carried out, the Iadov technique is used, and in particular the Neutrosophical Iadov is used, a technique that when using Neutrosophy provides accurate results and contributes to a greater interpretability of qualitative information, and in particular of linguistic terms, useful for decision-making support. Conclusions are presented that indicate how knowledge of cutting meat behaves, in the Patate canton of Ecuador and where emphasis should be placed to obtain a gastronomy of excellence and quality.

**Keywords:** beef cutting, beef quality, neutrosophic Iadov technique, single-valued neutrosophic number.

## 1 Introduction

In Ecuador, there is a high rate of meat consumption, gastronomic establishments and the population demand this product, however the difficulty is perceived, in restaurants, that the cuts of meat are mixed, which affects the quality of the final product. To the consumer, in the Canton Patate, this situation is frequently and specifically evident with regard to the culinary, since when adequate cuts of meat are not established, they are not cooked properly, feeling their hardness when subjected to the cooking, which affects the profitability of the suppliers of these gastronomic sites.

The waste of meat due to its inadequate handling has a significant impact on the gastronomic economy and on the culinary art itself. In Cantón Patate, people do not know the types of cuts that can be made in meats, nor do they have sufficient knowledge of the temperature and terms necessary for their cooking, this ignorance affects the offers that are offered to customers in different gastronomic centers and affects that meat substitute products overshadow roasts.

Based on the aforementioned, in the present work it is emphasized in the cuts of beef, specifically, because in the Canton Patate, livestock is varied and its products are not sufficiently used, due to the existing ignorance of the cuts of beef from cattle. He reports [1] that in the Patate canton, the consumption rate of beef is high, as is the consumption of others. Gastronomic establishments and the population demand these products.

There is difficulty in the restaurants that offer roasts, which is accentuated in the cuts of meat that are not standardized and they do it in a mixed way, which affects the quality of meat products, causing confusion for consumers. In the Patate canton, the situation is exacerbated, due to the chef's inability to apply adequate cooking terms to meats with bad cuts, which causes a hard texture when cooked and its quality is affected.

"Quality is the set of characteristics of a product or service that satisfies the explicit or implicit wishes of the consumer" ([1]), in this regard the quality of the meat in the gastronomic centers of the Patate canton is expressed

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in the tenderness of meat and its juiciness, which are considered important attributes that influence its sensory quality and consumer acceptability. Other factors such as the organoleptic and aesthetic physical conditions may also influence the degree of maturation, the attributes of the container and its ability to preserve the product.

The nutritional contribution, the freshness of the cut and the viability of the preparation, are reasons why it is important to study how to make high quality cuts of meat, so that they contribute to the acceptance and satisfaction of customers when they consume roasted preparations of meats. Other quality aspects to take into account are the age of the animal, sex, breed, food, the area where the piece comes from and the cut made are factors that affect the flavor of the meat, which sometimes it is varied, in the texture that affects the rating given to the meat.

On the other hand, the meat is classified, depending on the age, this can be veal, craving, ox, cow and bull and in some cases they are differentiated with some not excessively clear names, such as fattened and grazing calf, among others, [2]. Studies in this regard are evidenced by [3-5] [1].

Due to the existing problems in Canton Patate, the standardization of cuts of meat from cattle and other meats was recommended. Standardization according to [4], means specifying quantity, quality and procedure of the meat to achieve a suitable product.

The standardization of selected cuts of meat from beef cattle for roasts is carried out to ensure that establishments that distribute this type of cut have an adequate and quality procedure to ensure that they are the correct size and shape for distribution to different types of restaurants. and that they make a correct preparation when serving consumer preparations.

Once the standardization process was carried out, the satisfaction level of the suppliers of different gastronomic sites in the Canton Patate was evaluated, in order to analyze whether the proposed standardization of meat cuts is feasible and profitable for the gastronomic centers of the aforementioned Canton. The Neutrosophical Iadov technique is used to assess the level of satisfaction.

The Neutrosophical Iadov technique arises from the Iadov technique, which owes its name to its creator V. A. Iadov. Researchers have used it in different studies to study the level of user satisfaction in various contexts. Its extension to Neutrosophy has been used in different studies such as, for example, the studies of [6], [7], [10-15]

The fundamental basis of the technique consists of three closed questions interspersed in a questionnaire and whose relationship the respondent does not know and two open questions. Its objective is the assessment of the level of satisfaction according to what is known as the "Iadov logical table." The answer to these questions allows locating, according to the logical table, on a satisfaction scale, and then calculates the Group Satisfaction Index (ISG).

In the present investigation, it is used as a Neutrosophical Iadov, to analyze the level of satisfaction of the suppliers of different gastronomic sites in the Canton of Patate, in order to analyze whether the proposed standardization of cuts of meat is feasible and profitable for gastronomic centers. of said Canton. For this purpose, a questionnaire was designed with a specific internal structure that the interviewee does not know, [6-7].

The designed questionnaire was adapted to analyze the satisfaction of the suppliers of different gastronomic sites in the Canton Patate, in order to analyze whether the proposed standardization of cuts of meat is feasible and profitable for the gastronomic centers of the aforementioned Canton Patate. The internal structure of the questionnaire follows a relationship between three closed questions, the relationship between the closed questions is established through the so-called "Iadov Logic Graph".

The authors [8-12] and [2], use the Neutrosophical Iadov technique and incorporate indeterminacy which is treated by Neutrosophy, its main advantage lies in the possibility of responding with linguistic terms, instead of useful numerical values for obtain greater interpretability of qualitative information, and in particular linguistic terms, in order to obtain accurate results to support decision-making regarding the standardization of meat cuts and that suppliers obtain higher quality and profitability in gastronomic centers.

## 2 Neutrosophic Iadov technique

This section is dedicated to exposing the main definitions and procedures of the Neutrosophical Iadov technique. Iadov's technique is based on the processing of a survey designed to investigate the causes of a certain social phenomenon.

The designed survey has three closed questions and the answers are analyzed according to the satisfaction level assessment according to what is known as the "Iadov logical table." The interviewees do not know the relationship between the three questions, for the analysis of the present indeterminacy, (not defined) (I), some open questions are provided that are analyzed through a process of de-neutrosificación as proposed by Salmerona and Smarandache [16-18]. In this case,  $I[-1,1]$ .

**Definition 1** ([13-14]) Let  $X$  be a universe of discourse, a space of points (objects) and  $x$  denotes a generic element of  $X$ . A *neutrosophic set*  $A$  in  $X$  is characterized by a truth-membership function  $T_A(x)$ , an indeterminacy-membership function  $I_A(x)$ , and a falsity-membership function  $F_A(x)$ . Where,  $T_A(x), I_A(x), F_A(x) \subseteq ]0, 1+[$ , i.e., they

are real standard or nonstandard subsets of the interval  $]0, 1^+[$ . These functions do not satisfy any restriction, that is to say, the following inequalities hold:

$$0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^+$$

**Definition 2** ([15-16]) Let  $X$  be a universe of discourse, a space of points (objects) and  $x$  denotes a generic element of  $X$ . A *Single Valued Neutrosophic Set* (SVNS)  $A$  in  $X$  is characterized by a truth-membership function  $T_A(x)$ , an indeterminacy-membership function  $I_A(x)$ , and a falsity-membership function  $F_A(x)$ . Where,  $T_A(x), I_A(x), F_A(x): X \rightarrow [0, 1]$  such that:  $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$ . A *single valued neutrosophic number* (SVNN) is symbolized by  $\langle T, I, F \rangle$  for convenience, where  $T, I, F \in [0, 1]$  and  $0 \leq T + I + F \leq 3$ .

Therefore,  $A = \{ \langle x, T_A(x), I_A(x), F_A(x) \rangle : x \in X \}$  or more straightforwardly  $A = \langle T_A(x), I_A(x), F_A(x) \rangle$ , for every  $x \in X$ .

Let  $A$  and  $B$  be two SVNSs, the following operations are defined:

1.  $A \subseteq B$  if and only if  $T_A(x) \leq T_B(x)$ ,  $I_A(x) \geq I_B(x)$  and  $F_A(x) \geq F_B(x)$ . Particularly,  $A = B$  if and only if  $A \subseteq B$  and  $B \subseteq A$ .
2.  $A \cup B = \langle \max(T_A(x), T_B(x)), \min(I_A(x), I_B(x)), \min(F_A(x), F_B(x)) \rangle$ , for every  $x \in X$ .
3.  $A \cap B = \langle \min(T_A(x), T_B(x)), \max(I_A(x), I_B(x)), \max(F_A(x), F_B(x)) \rangle$ , for every  $x \in X$ .

A scoring function  $s: [0, 1]^3 \rightarrow [0, 3]$  is defined in Formula 1, thus, an adapted scoring function in [9] is used to sort the alternatives.

$$s(a_j) = 2 + T_j - F_j - I_j \quad (1)$$

Where  $a_j$  is an alternative evaluated with the SVNN  $(T_j, I_j, F_j)$ .

The definition of precision index is given in Equation 2.

$$a(a_j) = T_j - F_j \quad (2)$$

Where  $a: [0, 1]^3 \rightarrow [-1, 1]$ .

We prefer to score the options according to precision with Equation 2.

**Definition 3.** The *Neutrosophic Logic* (NL) is the generalization of the fuzzy logic, where a logical proposition  $P$  is characterized by three components:

$$NL(P) = (T, I, F) \quad (3)$$

Where the neutrosophic component  $T$  is the degree of truthfulness,  $F$  is the degree of falsehood, and  $I$  is the degree of indeterminacy ([17]).

Based on the aforementioned concepts, the individual satisfaction scale shown in Table 1 was used to measure the individual satisfaction of each respondent associated with a linguistic term. Observe that the scores are those used in [9].

Number	Expression	SVNN	Score (Precision function)
1	Clear satisfaction	(1, 0, 0)	1
2	More satisfied than dissatisfied	(1, 0.25, 0.25)	0.75
3	Not defined	(0.5, 0.5, 0.5)	0
4	More dissatisfied than satisfied	(0.25, 0.25, 1)	-0.75
5	Clear dissatisfaction	(0, 0, 1)	-1
6	Contradictory	(1, 0, 1)	0

**Table 1:** Individual satisfaction scale.

Fuzzy aggregation operators are used to solve group decision problems; this concept can be extended to the neutrosophical framework. Neutrosophical aggregation operators are formally defined in definition 4 they are used in the present work to analyze the results of open questions and in particular when using the De-neutrosophication process to treat indeterminacy.

**Definition 4** Let  $X$  be a universe of discourse, a space of points (objects) and  $x$  denotes a generic element of  $X$ .  $A$  is a *Single Valued Neutrosophic Aggregation Operator* (SVNAO) if it is a mapping  $A: \cup_{n \in \mathbb{N}} ([0, 1]^3)^n \rightarrow [0, 1]^3$ .

One example of SVNAO is the *Weighted Average operator (WA)*, which is shown in Equation 4.

$$WA(a_1, a_2, \dots, a_n) = \sum_{i=1}^n w_i a_i \tag{4}$$

Where,  $a_i = (T_i, I_i, F_i)$  are SVNNs and  $w_i \in [0, 1]$  for every  $i = 1, 2, \dots, n$ ; which satisfy the condition  $\sum_{i=1}^n w_i = 1$ . The  $a_i$ s are the values obtained for the  $i^{th}$  alternative assessment, and  $w_i$  denote the weight which represents the importance given to the alternative  $a_i$ .

The Weighted Average operator was used in [8] like an index of agreement, it was called Group Satisfaction Index (GSI).

Briefly, the proposed neutrosophic Iadov technique consists in the following steps:

1. Each interviewed person says his or her criterion for every of the three closed questions, according to Table 1. The only three possible answers for questions 1 and 2 are either, “Yes”, “I don’t know” or “No”. The third question has six possible answers, namely, “Very satisfied”, “Partially satisfied”, “I don’t care”, “More unsatisfied than satisfied”, “Not at all satisfied”, and “I don’t know what to say”.
2. For each triplet of answers given by each interviewed, one answer per question, a number in Table 1 is taken from the intersection cell, with values ranged from 1 to 6.
3. The number obtained in the previous step is selected in the first column of Table 1. It is associated to its corresponding SVNN, in the second column of the table.
4. Every person’s opinion is associated with an importance weight,  $w_i \in [0, 1]$  for every  $i = 1, 2, \dots, n$ ; which satisfy the condition  $\sum_{i=1}^n w_i = 1$ . This step is necessary when the opinion is given by experts and the expertise level will be taking into account. Otherwise, it is recommendable to assume  $w_i = \frac{1}{n}$  for every  $i = 1, \dots, n$ .
5. The person’s opinions are aggregated using the Weighted Average operator defined in Equation 4, it is the GSI.
6. Calculate  $a(GSI)$ .
7. Calculate the closest score to  $a(GSI)$  from those appeared in the last column of Table 1. When  $a(GSI)$  is equally closest to two different values, the selection is made by means of the score function given in Equation 1.
8. In case that the final score is 0, which means not defined or contradiction, the final criterion is obtained from the answers given to the open questions.

The questionnaire is supported in the “Iadov Logic Chart” represented in Table 2.

	1. Question 1								
	No			I don't know			Yes		
3. Question 3	2. Question 2								
	Yes	I don't know	No	Yes	I don't know	No	Yes	I don't know	No
Very satisfied.	1	2	6	2	2	6	6	6	6
Partially satisfied.	2	2	3	2	3	3	6	3	6
I don't care.	3	3	3	3	3	3	3	3	3
More unsatisfied than satisfied.	6	3	6	3	4	4	3	4	4
Not at all satisfied.	6	6	6	6	4	4	6	4	5
I don't know what to say.	2	3	6	3	3	3	6	3	4

**Table 2:** A generic logic table by V.A. Iadov to measure the relationship among the three closed questions.

### 3 Results

This section is devoted to show the results of applying the neutrosophic Iadov technique to analyse the problem of standardization of the beef cutting for roasting in Patate canton. For this, 53 owners and chefs of roast restaurants, and culinary specialists were asked about the quality of the roast beef cutting in the restaurants of the canton. The questions were the three following:

1. Do you consider that there is a good training in the restaurants of meats or barbecues that offer different types of fine cuts on your menu?
2. Do you think that the elaboration and socialization of the standardization sheet of fine cuts - which includes weight, temperature, dishes in which the different cuts are used - will be effective for leveling in all places and to establish the proper way to offer them?
3. How do you assess your satisfaction about the quality of dishes with fine cuts in roast restaurants and barbecues in Patate canton?

Additionally, we applied a survey from the viewpoint of the customers. The sample consisted in 373 citizens of the Patate canton, aged from 17 to 55 years old. The three questions were the following:

1. Do you know the different kinds of beef cuttings?
2. Do you have visited restaurants with a menu containing roasted beef in Patate canton?
3. How do you assess your satisfaction respect to the service in the visited restaurants about the roasted beef?

Tables 3 and 4 are the Iadov's logic tables for the specialists and customers' opinions, respectively:

	1. Do you consider that there is a good training in the restaurants of meats or barbecues that offer different types of fine cuts on your menu?								
	Yes			I don't know			No		
3. How do you assess your satisfaction about the quality of dishes with fine cuts in roast restaurants and barbecues in Patate canton?	2. Do you think that the elaboration and socialization of the standardization sheet of fine cuts - which includes weight, temperature, dishes in which the different cuts are used - will be effective for leveling in all places and to establish the proper way to offer them?								
	Yes	I don't know	No	Yes	I don't know	No	Yes	I don't know	No
Very satisfied.	1(1)	2(1)	6	2	2	6	6	6	6
Partially satisfied.	2(7)	2(3)	3	2(3)	3	3	6(8)	3	6
I don't care.	3	3	3	3	3	3	3	3	3
More unsatisfied than satisfied.	6(4)	3	6	3(2)	4	4	3	4	4(6)
Not at all satisfied.	6(2)	6	6	6(9)	4	4	6	4(3)	5(4)
I don't know what to say.	2	3	6	3	3	3	6	3	4

**Table 3:** Iadov's logic table on the questionnaire applied to the specialists.

	1. Do you know the different kinds of beef cuttings?			
	Yes		No	
3. How do you assess your satisfaction respect to the service in the visited restaurants about the roasted beef?	2. Do you have visited restaurants with a menu containing roasted beef in Patate canton?			
	Yes	No	Yes	No
Very satisfied.	1(9)	6	6(2)	6
Partially satisfied.	2(67)	3	6(108)	6
I don't care.	3	3	3(2)	3
More unsatisfied than satisfied.	6(34)	6	3(51)	4
Not at all satisfied.	6(3)	6	6(8)	5
I don't know what to say.	2(12)	6(21)	6	4(56)

**Table 4:** Iadov's logic table on the questionnaire applied to the customers.

Let us observe that the numbers in parenthesis in Tables 3 and 4 correspond to the number of interviewed who answered to the corresponding responses. Let us note that Table 4 does not contain the term "I don't know" because it does not proceed according to the questions. Tables 5 and 6 summarize the results of service satisfactions given by specialists and customers, respectively.

Expression	Total	Percent
Very satisfied.	2	3.77%

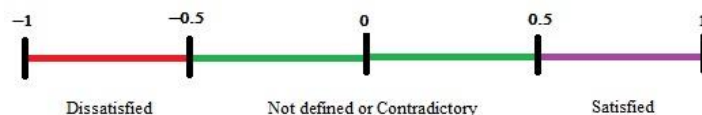
Partially satisfied.	21	39.62%
I don't care.	0	0%
More unsatisfied than satisfied.	12	22.65%
Not at all satisfied.	18	33.96%
I don't know what to say.	0	0%

**Table 5:** Summary of the survey results applied to the specialists.

Expression	Total	Percent
Very satisfied.	11	2.95%
Partially satisfied.	175	46.92%
I don't care.	2	0.54%
More unsatisfied than satisfied.	85	22.78%
Not at all satisfied.	11	2.95%
I don't know what to say.	89	23.86%

**Table 6:** Summary of the survey results applied to the customers.

Thus, for the specialists along with Table 3 we obtain  $a(\text{GSI}) = 0.014151$ , whereas for the customers we calculated  $a(\text{GSI}) = 0.070375$ . Both results are slightly positive, in the interval  $(-0.5, 0.5)$ . Let us classify these results by comparing with the scale in Figure 1, see [8],[3, 4] thus, they are contradictory or indeterminate. Nevertheless, experts consider these results are not good because there not exist negligible deficiencies in the quality of this kind of service, and to apply an open question survey is not necessary.



**Figure 1:** Scale of group satisfaction of the Iadov's technique.

## Conclusion

In the article a study is made of the real situation of the knowledge of the cut of the meat, for a gastronomy of excellence and quality in the canton Patate of Ecuador, because the meat by its characteristics is an important food in the diet of the being human, its consumption allows economic development; Reason that for gastronomic ventures have good yields and excellent customer satisfaction, they must take into account the cuts of meat, when purchasing it and then offer them. The standardization of meat cuts is a useful tool that gastronomic entrepreneurs must know.

To analyze the satisfaction level of standardization of cuts of meat, in order to obtain greater profitability in gastronomic centers, the Iadov Neutrosófico technique was used, the results obtained are not considered good enough in terms of satisfaction of site providers of gastronomy of the Canton Patate, since the proposal of standardization of cuts of meat is unknown and, in turn, such ignorance affects the profitability of the gastronomic centers of the aforementioned Canton.

These conclusions were reported to restaurant owners and others related to this business with the aim of applying the necessary measures to improve the aforementioned situation. We propose to repeat this investigation once the necessary measures have been taken, to calculate the degree of evolution in this aspect of restaurants, barbecues and the rest of the gastronomic centers of the Patate canton of Ecuador.

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