A Graph Networks Based Quality Control Model For Packaged Food Smart Traceability & Communication

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Abstract: Usually,foods are packaged with some preservative and such chemicals in the form of organic and inorganic preservative are being used for packaging different types of food.But in India, companies are using inorganic preservatives mostly and these inorganic preservatives are very harmful to human's body. In this paper, a new model is developed to reduce the quantity of chemicals in packaged food. This problem is modelledby fuzzy inference and is also combined with graphtheory methodology to provide a unique and defective solution.The sideeffectofeachpackagedfoodistobemeasuredusinga fuzzy interference system. A real-life application on Haringhatachicken has been presented in this paper by using fuzzy inference logic and graph theory. At last, a comparison of the result hasbeendemonstrated to justify the solution.

Keywords: Graph Theory, Fuzzy InferenceRule, Food Preservative, Index of Side Effect.

1. INTRODUCTION

Into the recent era, the popularity of packaged food is growing day by dayinto human's life. The main reasonsto eat such packagedfood are convenient, less preparation time, inexpensive and sometimes astesty. In general, such foods are prepared and packaged atvarious factories where they further are transported into different cities. But, due to transport over the long route, suchfood quality is degradable.Thus, these companies use several preservatives which in general are harmful to a human body. Various types of preservatives are used for packaging different kinds of food. Some of these preservatives are organic as well as inorganic depending on its variety. But, in most of the developing countries, companies use maximum inorganic chemicals. Inorganic preservatives are very harmful tothe human body. One ofthe most popular inorganic preservatives is “potassium sorbate”. However, two studies have shown that potassium sorbate has the potential to mess human’s DNA [4, 5]. So, the quantity of these preservatives in packagedfood is insignificant. Zajacet al. [12] described the effects of usually used milk preservatives on fat, protein, lactose and non-fat solids in milk. Rajbanshi et al. [13] proposed to minimize the quantity of food preservatives with the ionic liquid mixture for monitoringthe risk factor in the humanbody.

Depending on distances from manufacturing food factory, these packaged food outlets are classified in different circles.Within each circle, same preservatives are to be used. In general, it is well known that if the amount of preservatives increases the expiry date is also increases, up to contain limit This paper provides an extensive study that focuses on the side effect of packaged food with the help of graph theory [16-18]. A new graph, called D-graphs is used to represent food outlets. In this study, the main objective is to conclude that the amount of preservative in package food should be reduced maintaining the food quality. It is also obvious that a low amount of preservative may be used for a food of short expiry date.

Chemical compound	**Type of food**
Sodium propionate and Propionic acid	Common for baked goods
Sodium sorbate, Sorbic acid and Sorbates	Used in wine, cheese, baked goods
Hydroxybenzoate and derivatives	Used for stable at a broad ph range
Sodium benzoate, Benzoic acid and Benzoates	Common for acidic foods such as pickles, jams, juices, salad dressing, soy sauce, carbonateddrinks
Sulfur dioxide and sulfites	Used for fruits
Nitrite	Common for meats to prevent botulism toxin
Nitrate	Common for meats

Table 1: Some commonly used preservatives

Hence, a low amount of preservative may be used for the food of low distance outlets. Thus, it is assumed that short distant outlets will be provided package food of short expiry date and high distant outlets will be provided package food of long expiry date. Therefore, the amount of preservative is proportional to the distance between outlets and food factory. Inthis study, a new model is developed to reduce the quantity of preservatives in packaged food. Also, this research paper introduces a new measure of quality intopackaged food as“IndexofSideEffect”usinggraphtheory.Also,this“IndexofSideEffect”iscalculated by fuzzy inference logic. The Fuzzy inference logic, and its associated algorithms were initially definedby Zadeh [7, 8, 9]. After that Mamdani [1] used this terminology of fuzzy based logic with stream machine. Fuzzy inferencelogic has been determined at various field like bankingand healthcare and education sector. Gokemen et al. [2]

applied fuzzy logic for evaluation of student presentation in laboratory application. Khan [3] proposed a form of fuzzy logic in a teachers performance analysis in an educational institution. In this study, fuzzy logic hasbeenusedtodeterminetheIndexofsideeffectinpackagedfood.

Mathematical Criteria for Estimation Quality Control of Packaged Food

A graph is an ordered pair ofa set of vertices and a set of edges such that each link is connected with a pair of vertices.A weighted graph [10, 11] is a graph in which all edge is assigned a numerical weight.

Notation	**Meaning**
G	Crisp graph
V	Set of vertices
E	Set of edges
$\mu(x, y)$	Weight of the edge (x, y)
$p_i(x, y)$	i^{th}path from x to y
d or $d_{x,y}$	$d_{x,y} = \min_i \sum_{e \in p_i(x,y)} \mu(x,y)$
k	Parameter inversely proportional to Index of preservative
$f(v_i)$	Index of side effect of food at the outlet v_i

Table 2: Some basic notations

Let,uandvbetwooutlets,and$d_A(u,v)$betheactualdistancebetweenuandv.LetDbe apre-assumednumber,andthevalueofDliesbetweenmin$\{d_A(u,v)\}$andmax$\{d_A(u,v)\}$. For the set of outlets and factory construct a graph G = (V, E) whose vertices are outlets and the factory. An edge joins two vertices in G if $d_A(u, v) \leq D$. The distance between the vertices u and v in G is denoted by $d_G(u,v)$.

A food company uses a preservative to preserve food for a distinct time from production factory to outlets [15]. A food company marks the expiry date on the packet depending on some parameters which are listed below:

(i) the actual distance between the production factory andoutlets
(ii) the demand for the product in themarket
(iii) preservativeused

Suppose, a food company supplies food to n outlets from a production factory. Also, consider $v_1, v_2, \ldots, v_n$are the outlets, and u be the production factory then all the outlets and production factory can be taken as the vertices of a weighted graph. Let the set of vertices be $V = \{v_1, v_2, \ldots, v_n\}$. There is an edge if the actual distance amongtwo vertices is less than or equal to D.Also, the weight of an edge is the actual distance between these two vertices. Now, $d_j$is the shortest distance between the factoryvertex(u) and any other vertex $v_j \in V$ for any j. Then the index of side effect of a particular food at outlets $v_i$is denoted by f (v_i) and defined by

$$f(v_i)=k^2\frac{d_i}{D}$$

where i = 1, 2, . . . , n and k is the factor of side effect due to the mixing ofpreservative, and it is directly proportional to the amount of preservative added in a particular food packet. Also, the amount of preservative is proportional to the actual distance between the food factory and outlets. To emphasise the side effect of the amount of preservative, the term square of “k” isused.

Example 1 Suppose, a food company supplies food from a production factory (A) to four outlets namely, B, C, D, E. The actual distance between any two outlets and production factory is shown in Table 3.

Now, all the outlets and production factories (A) are taken as the vertices of the weighted graph and there exists an edge if their actual distance is at most 10 K.M. For this example, consider D= 10K.M. Using these criteria, the graph of Figure 1(a) is obtained.

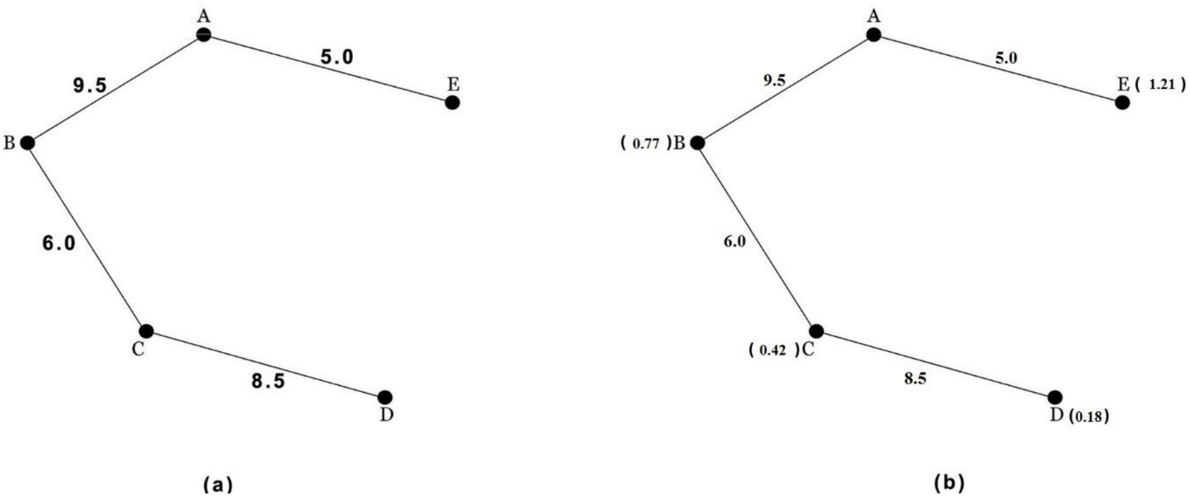

Figure1:(a)Graphwithfouroutlets(B,C,D,E)andafoodfactory(A)(thenumbers besidetheedgesaretheactualdistances),(b)Aweightedgraph(thenumbersbesidethe vertices are an index of a sideeffect)

	A	B	C	D	E
A	–	9.5	14.0	22.0	2.0
B	9.5	–	6.0	12.0	14.0
C	14.0	6.0	–	8.5	14.6
D	22.0	12.0	8.5	–	16.0

Table 3: Actual distance between two outlets and food factory

Now, the weight of an edge is the actual distance between these vertices and the weight are shown in Table4.

For this calculation consider the value of the parameter k as 2. Now, the value of $d_i$is the shortest distance between the factory vertex(A) to other outlets. Then the index ofsideeffectofaparticularfoodatanoutlet$v_i$isf(v_i)andcalculatedbytheformula $f(v_i) = k^{\frac{2d_i}{D}}$, where i = 1, 2, . . . , 4. All the value of index of side effect are tabulatedin Table 5.

Edge	Edge weight
(A, B)	9.5
(A, E)	2.0
(B, C)	6.0
(C, D)	8.5

Table 4: Edge weight of the graph of Figure 1

Outlet	The actual distance from a foodfactory (K.M.)	Shortest path	Value of d_i	Index of side effect
B	9.5	A − B	9.5	3.8
C	14.0	A − B − C	9.5+6.0=15.5	6.2
D	22.0	A − B − C − D	9.5+6.0+8.5=24	9.6
E	5.0	A − E	2	0.8

Table 5: Calculation of the index of side effect.

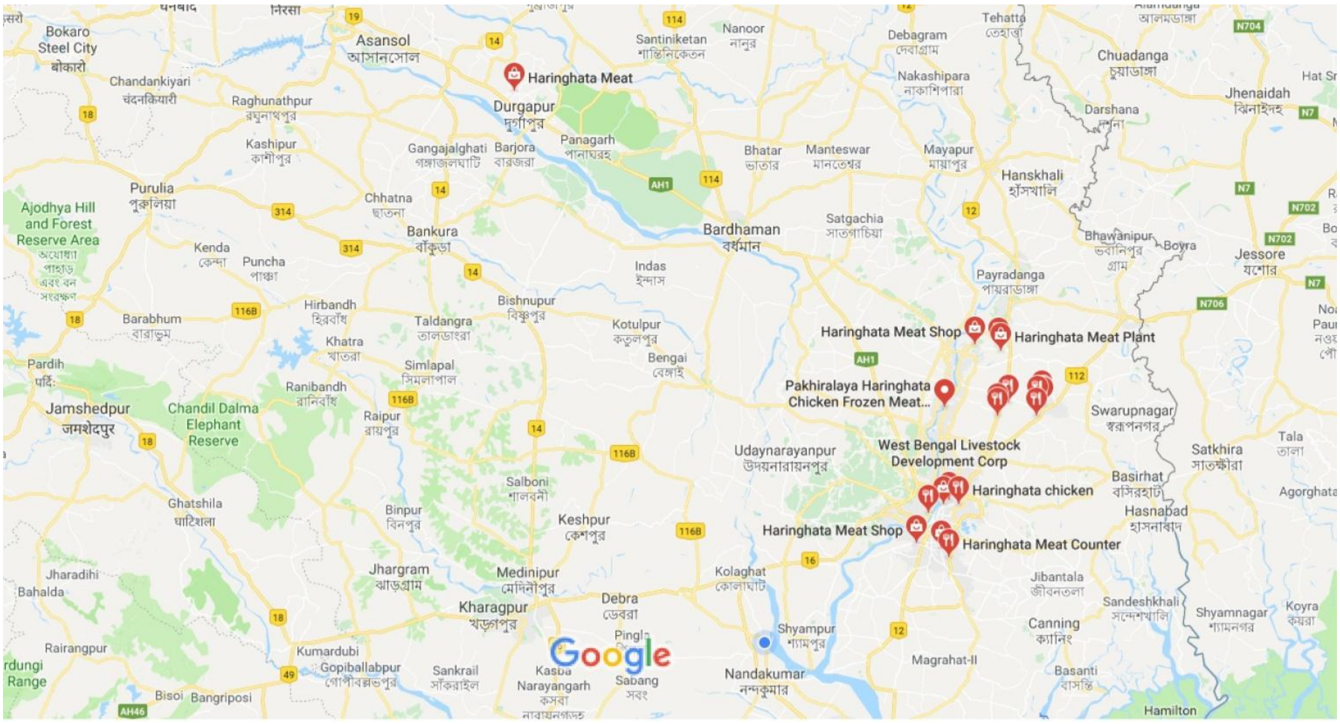

Figure 2: Some outlet of Haringhata Chicken in West Bengal

Prediction Model for Packaged Food using Graph Theory

Inthissection,the main focus has been given on HaringhataChickeninWestBengal,Indiaasa casestudy.For this purpose, some district wise outlets and chicken factory of Haringhata Chicken in WestBengal,IndiahavebeencollectedfromtheofficialwebsiteofHaringhataChicken (http://wbldc.in/storeoutlet.php).Also,theoriginalpositionsof theoutletsandchickenfactoryhavebeenshownusingGoogleMapinFigure2.Also,the originalpositionofoutletsandchickenfactoryhavebeenplottedinWestBengalmapis showninFigure3.Additionally,theactualdistancesbetweenanytwooutletsandchicke n factoryhavebeenmeasuredinGoogleMap(seeFigure4).Alltheoutletsandchicken factoryareassumedasverticesofthegraph.Thefirstcolumn of value is denoted the vertex number of the corresponding graph. Considering these notations, the actual distance between any two outlets and chicken factory aretabulated in Table6.

Figure 3: District wise outlet of Haringhata Chicken in West Bengal

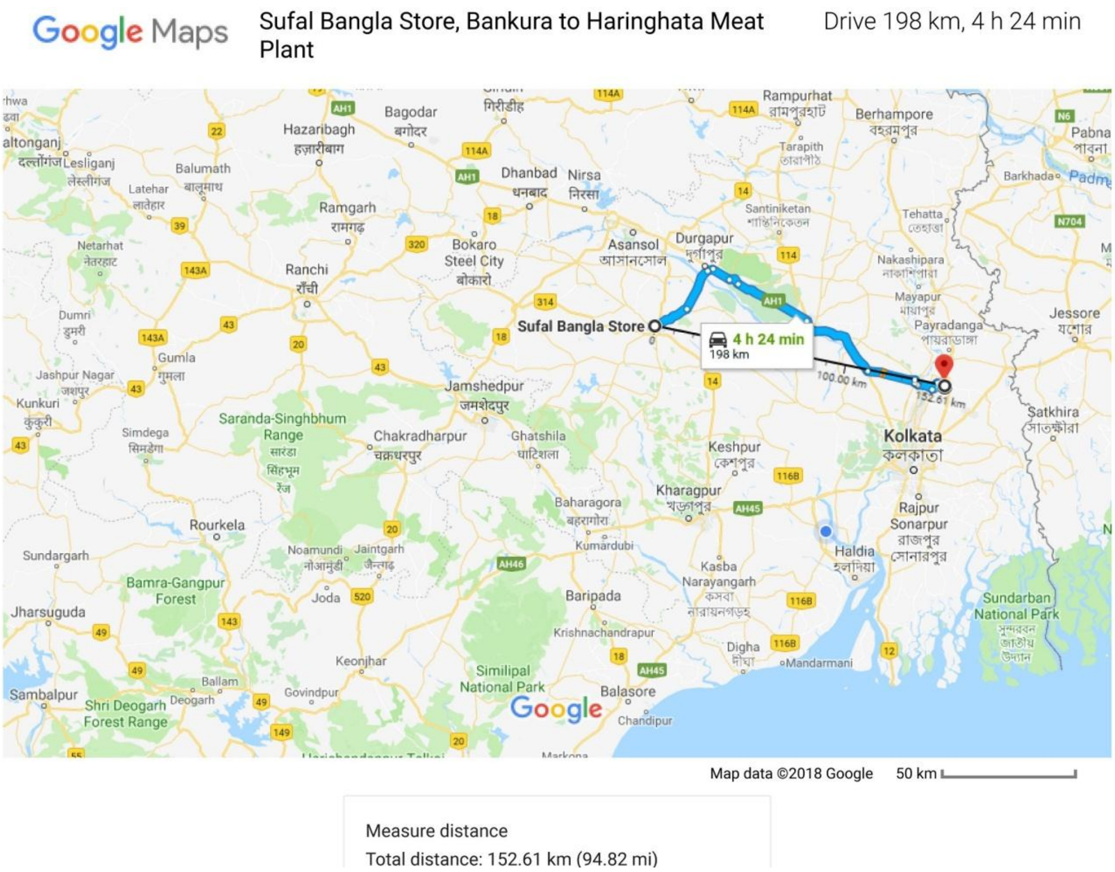

Figure 4: Actual distance measure between two outlets of Haringhata Chicken in West Bengal

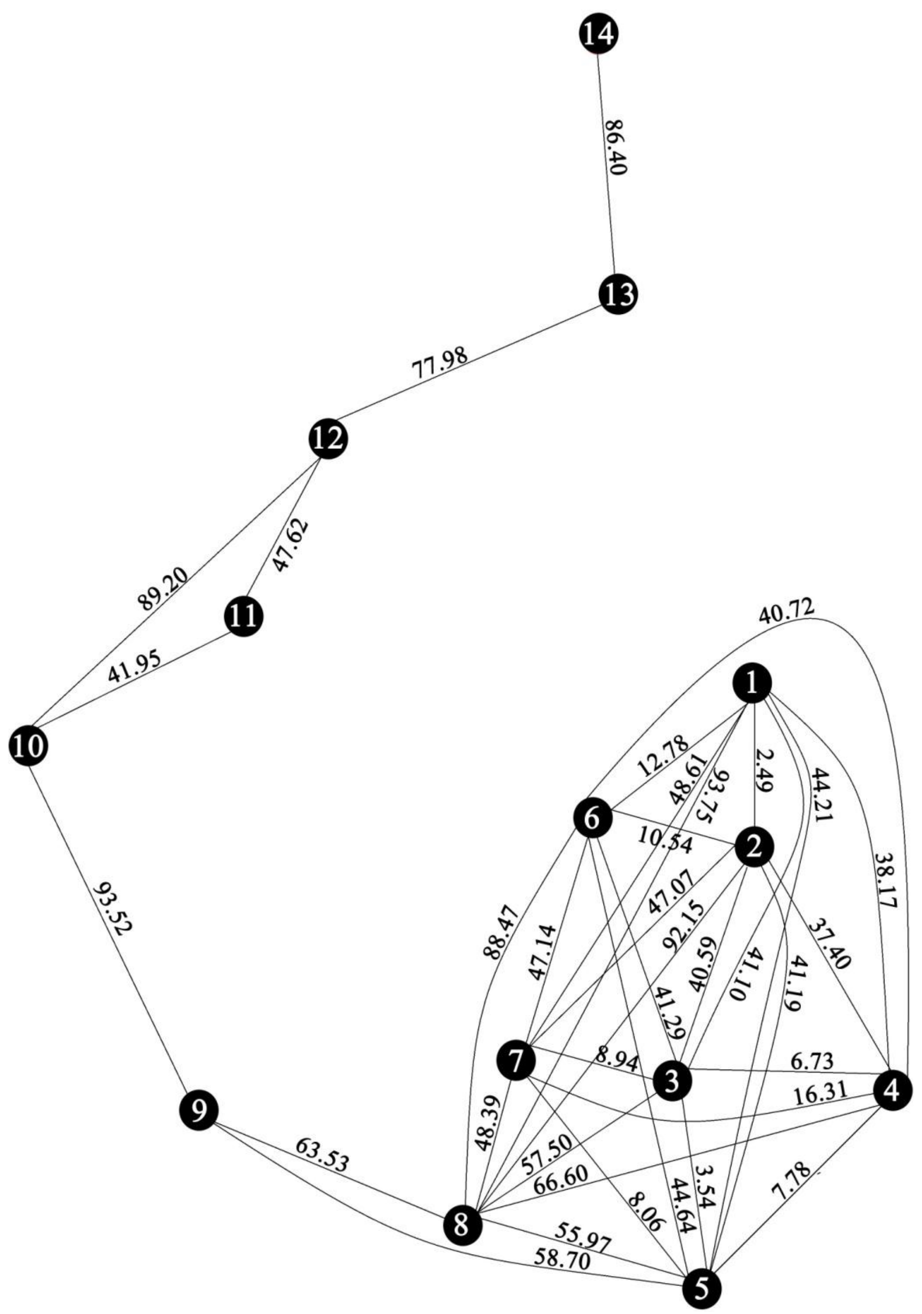

Figure 5: Graph with actual distance

–	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	–	2.49	41.1	38.17	44.21	12.78	48.61	93.75	136.68	152.61	142.88	147.05	131.05	219.78
2	2.49	–	40.59	37.4	41.19	10.54	47.07	92.15	134.33	150.32	140.65	145.43	131.31	217.11
3	38.17	40.59	–	6.73	3.54	41.29	8.94	57.5	111.25	152.5	154.73	169.82	167.7	253.59
4	38.17	37.4	6.73	–	7.78	40.72	16.31	66.6	117.88	157.76	158.02	171.89	167.04	252.78
5	44.21	41.19	3.54	7.78	–	44.64	8.06	55.97	58.70	154.96	157.04	172.70	170.97	255.84
6	12.78	10.54	41.29	40.72	44.64	–	47.14	88.47	126.52	140.45	130.89	136.81	126.99	212.17
7	48.61	47.07	8.94	16.31	8.06	47.14	–	48.39	103.30	149.22	153.13	170.75	172.80	257.17
8	93.75	92.15	57.50	66.60	55.97	88.47	48.39	–	63.53	136.44	153.09	182.44	203.16	283.78
9	136.68	134.33	111.25	117.88	58.70	126.52	103.30	63.53	–	93.52	126.02	167.20	210.83	279.83
10	152.61	150.32	152.50	157.76	154.96	140.45	149.22	136.44	93.52	–	41.95	89.20	157.36	205.42
11	142.88	140.65	154.73	158.02	157.04	130.89	153.13	153.09	126.02	41.95	–	47.67	118.13	163.44
12	147.05	145.43	169.82	171.89	172.7	136.81	170.75	182.44	167.2	89.2	47.67	–	77.98	115.54
13	131.05	131.31	167.7	167.04	170.97	126.99	172.80	203.16	210.83	157.36	118.13	77.98	–	86.4

Table 6: Actual distance (K.M.) between two outlets and food factory of Haringhata chicken in West Bengal

In this proposed weighted graph, D is taken as 100.0 K.M. By this value of D a weighted graph is drawn and which is shown in Figure 5. Also, this graph is drawn as per real outlet position in West Bengal map. The characteristic of this graph is that there is no edge between the vertices whose actual distance is more than the value of D i.e. 100.0 K.M. Now, the weight of an edge is the actual distance between these vertices and edge weights are tabulated in Table 7. Also, d_i where $i=1,2,...,14$ is the shortest distance between the factory vertex 1 to another outlet i. All the value of d_i is tabulated in Table 8. In this case, consider k = 2. Based on these values of d_i and k the index of side effect ($f(v_i)$) of Haringhata Chicken at all outlets are calculated using the formula $f(v_i)=k^{\frac{2d_i}{D}}$, where i = 1, 2, . . . , 14 and it is tabulated in Table 8.

Edge	**Actual distance**	**Edge weight**	**Edge**	**Actual distance**	**Edge weight**
(1, 2)	2.49	2.49	(4, 5)	7.78	7.78
(1, 3)	41.1	41.1	(4, 6)	40.72	40.72
(1, 4)	38.17	38.17	(4, 7)	16.31	16.31
(1, 5)	44.21	44.21	(4, 8)	66.6	66.6
(1, 6)	12.78	12.78	(5, 6)	44.64	44.64
(1, 7)	48.61	48.61	(5, 7)	8.06	8.06
(1, 8)	93.75	93.75	(5, 8)	55.97	55.97
(2, 3)	40.59	40.59	(5, 9)	58.70	58.70
(2, 4)	37.40	37.40	(6, 7)	47.14	47.14
(2, 5)	41.19	41.19	(6, 8)	88.47	88.47
(2, 6)	10.54	10.54	(7, 8)	48.39	48.39
(2, 7)	47.07	47.07	(8, 9)	63.53	63.53
(2, 8)	92.15	92.15	(9, 10)	93.52	93.52
(3, 4)	6.73	6.73	(10, 11)	41.95	41.95
(3, 5)	3.54	3.54	(10, 12)	89.2	89.2
(3, 6)	41.29	41.29	(11, 12)	47.62	47.62
(3, 7)	8.94	8.94	(12, 13)	77.98	77.98
(3, 8)	57.5	57.5	(13, 14)	86.4	86.4

Table 7: Edge weights of the graph generated in Figure 5

Outlet	Actual distance	Shortest path	Value of d_i	Index of side effect
2	2.49	1 − 2	2.49	0.10
3	41.1	1 − 3	41.10	1.64
4	38.17	1 − 4	38.17	1.53
5	44.21	1 − 2 − 5	2.49 + 41.19 = 43.68	1.75
6	12.78	1 − 6	12.78	0.51
7	48.61	1 − 7	48.61	1.94
8	93.75	1 − 2 − 8	2.49 + 92.15 = 94.64	3.79
9	136.68	1 − 2 − 3 − 5 − 9	2.49 + 40.59 + 3.54 + 58.70 = 105.32	4.21
10	152.61	1 − 2 − 3 − 5 − 9 − 10	2.49+40.59+3.54+58.70+93.52 = 240.79	9.63
11	142.88	1 − 2 − 3 − 5 − 9 − 10 − 11	2.49+40.59+3.54+58.70+93.52 + 41.95 = 282.74	11.31
12	147.05	1 − 2 − 3 − 5 − 9 − 10 − 12	2.49+40.59+3.54+58.70+93.52 + 89.20 = 329.99	13.20
13	131.05	1−2−3−5−9−10−12−13	2.49+40.59+3.54+58.70+93.52+89.20+ 77.98 = 407.97	16.32
14	219.78	1−2−3−5−9−10−12−13−14	2.49+40.59+3.54+58.70+93.52+89.20+ 77.98 + 86.40 = 494.37	19.77

Table 8: Calculation of index of side effects

Decision-makers for Packaged Food using Fuzzy Inference Logic

There can be several parameters which could act as decision-maker for selection of variable. Such linguistic variables are factors for which values are words in a certain language. The linguistic variable is significant in the application of the fuzzy inference rule. Women's hight is also a linguistic variable whose values are very short, short, tall, very tall. For fuzzy inference logic system, the following steps are to be performed [19-20]. In the first step, fuzzification is madeand the last step is defuzzification along with considering all values to fuzzy inference logic.

For this particular case, two inputs are taken. These are the amount of preservatives and actual distances. These inputs may have several membership values. For simplification, the membership grades the inputs which are to be taken as very low, low, medium, high and very high on the aspect of the fuzzy-based rule. For this particular case, distance is considered as very low, low, medium, high and very high. And again, the amount of preservatives is taken as very low, low, medium, high and very high. The output of this fuzzy interference system is taken as the index of side effect for packaged food using an inorganic preservative. It is classified into five grades as very low, low, average, high and very high. In Figure 6 depicts particular inputs and outputs for fuzzy rule-based inference is shown in Table 9 on a scale of 1 to 5.

The several outputs of the results are shown in Figures 7, 8. In Figure 7, it is shown that if the amount of preservatives is high, the side effect is high. If additionally, distance is high, the side effect is also veryhigh.

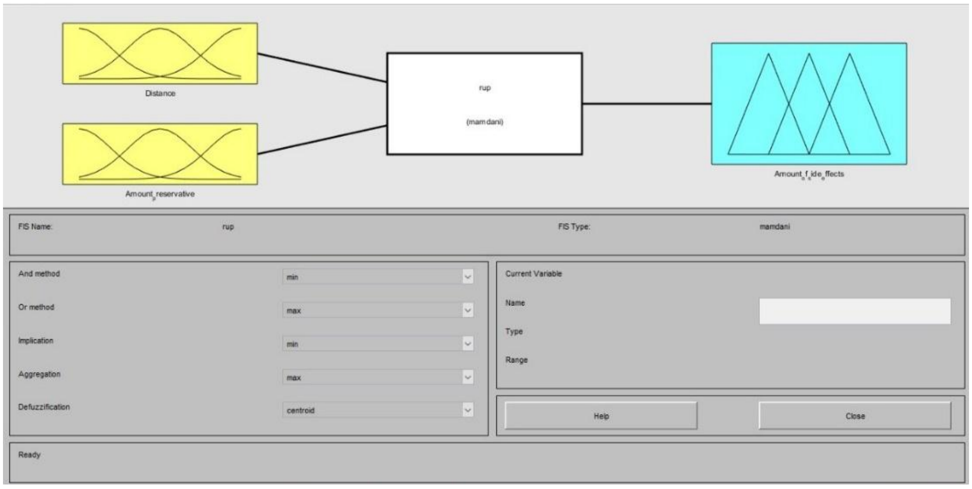

Figure 6: The inputs and outputs of the Fuzzy Inference System

Input	**Output**	**Input**	**Output**
[1,1]	1	[3,3]	3
[1,2]	1	[3,4]	3
[1,3]	2	[3,5]	4
[1,4]	2	[4,1]	2
[1,5]	3	[4,3]	3
[2,1]	1	[4,4]	4
[2,2]	2	[4,5]	4
[2,3]	2	[5,1]	3
[2,4]	3	[5,2]	3
[2,5]	3	[5,3]	4
[3,1]	2	[5,4]	4
[3,2]	2	[4,2]	3
		[5,5]	5
For input and output: 1-Very low, 2-Low, 3- Medium, 4- High, 5- Very high			

Table 9: The rule base for the fuzzy inference system

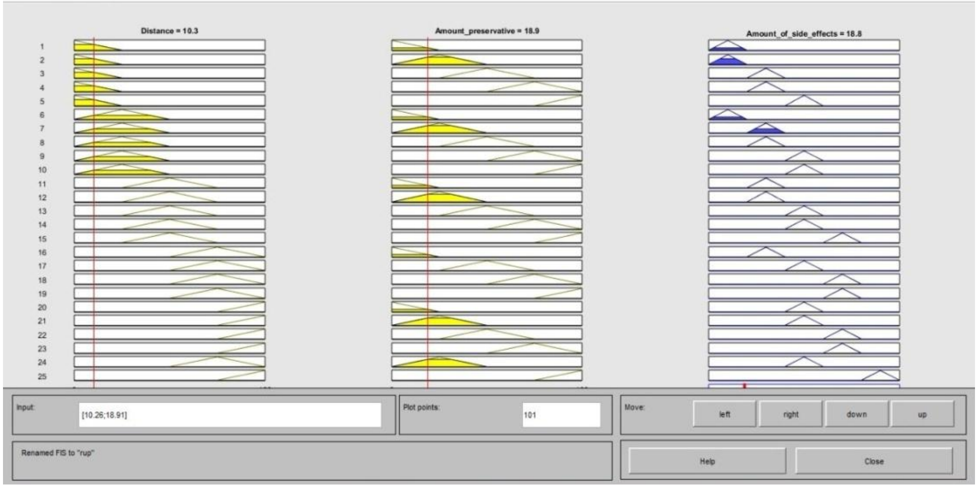

Figure 7: A case where distance and preservative are low aswell as the index of side effect is also low

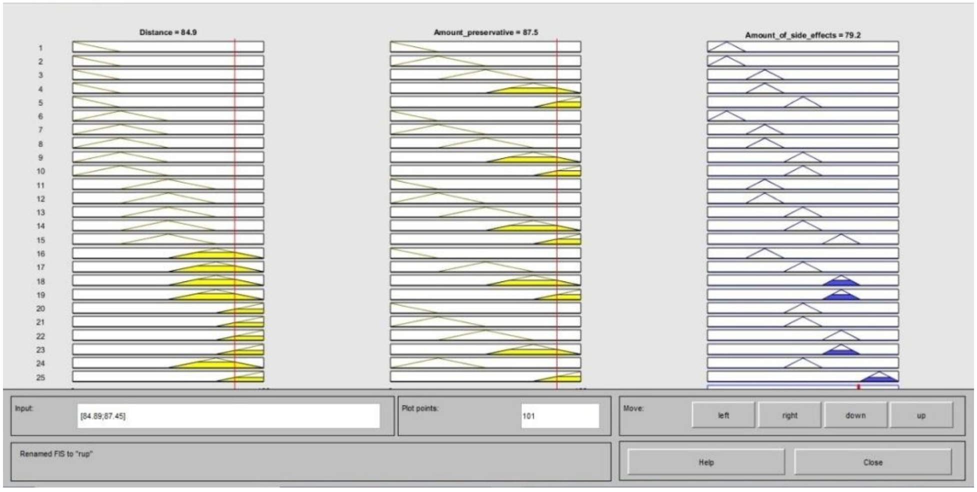

Figure 8: A case where distance and preservative are high as well as the index of side effect isalso high

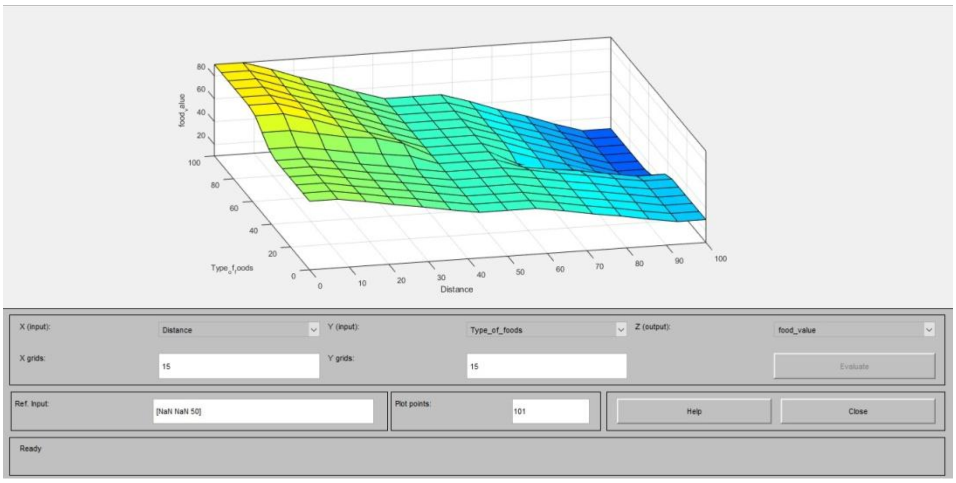

Figure 9: Surface view of Fuzzy Inference System

Outlet	**Actual distance**	**Shortest path**	**Value of** d_i	d_i**(Per-cent-age)**	**Index of side effect**
2	2.49	1 − 2	2.49	0.50	6.00
3	41.1	1 − 3	41.10	8.22	6.00
4	38.17	1 − 4	38.17	7.62	6.00
5	44.21	1 − 2 − 5	2.49 + 41.19 = 43.68	8.74	6.00
6	12.78	1 − 6	12.78	2.56	6.00
7	48.61	1 − 7	48.61	9.72	6.00
8	93.75	1 − 2 − 8	2.49 + 92.15 = 94.64	18.93	6.00
9	136.68	1 − 2 − 3 − 5 − 9	2.49 + 40.59 + 3.54 + 58.70 = 105.32	21.06	6.00
10	152.61	1 − 2 − 3 − 5 − 9 − 10	2.49 + 40.59 + 3.54 + 58.70 + 93.52 = 240.79	48.16	9.50
11	142.88	1 − 2 − 3 − 5 − 9 − 10 − 11	2.49 + 40.59 + 3.54 + 58.70 + 93.52 + 41.95 = 282.74	56.55	10.00
12	147.05	1 − 2 − 3 − 5 − 9 − 10 − 12	2.49 + 40.59 + 3.54 + 58.70 + 93.52 + 89.20 = 329.99	66.00	10.00
13	131.05	1−2−3−5−9−10−12−13	2.49 + 40.59 + 3.54 + 58.70 + 93.52 + 89.20 + 77.98 = 407.97	81.59	11.32
14	219.78	1−2−3−5−9−10−12−13+14	2.49+40.59+3.54+58.70+93.52+89.20+77.98+86.40 = 494.37	98.87	13.68

Table 10: Index of side effect of Haringhata Chicken, preservative fixed at 50%value

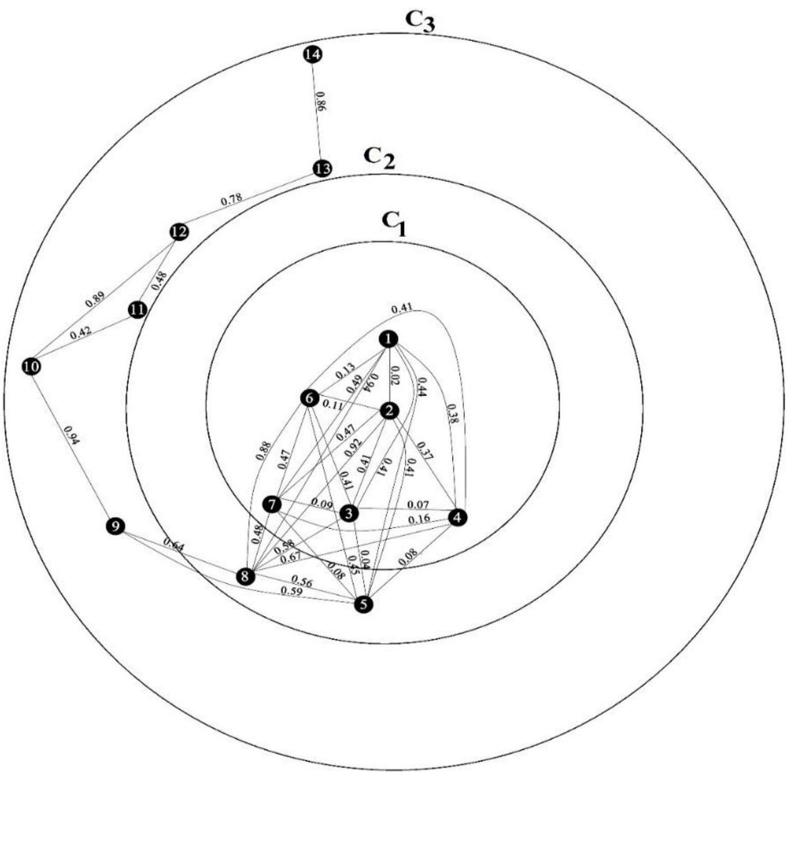

Figure 10: Proposed model for amount of preservatives

Calculation of Index of Side Effect using Fuzzy Inference Rule

In this proposed weighted graph, the maximum distance of the outlet is taken as fixed. Consideringthisfixeddistance withagraphdrawninFigure5,andthisgraphiscreated based on the realperception of the actual outletpositioninWestBengalMap.Thecharacteristicofthisgraphisthattherewill benoedgebetweentheverticeswhoseactualdistanceismorethan100.0km.Theedges weightaretabulatedinTable8.Now,d_i,i=1,2,...,14aretheshortestdistancebetween factory vertex 1 to its correspondent outlets. Index of side effect forHaringhata Chicken delivery at all outlets which is calculated by the values of $d_i$and as tabulated in Table 10. It is to be mentioned that the amount of preservatives is medium. These characteristics are kept fixed for this fuzzy interferencesystem.The3Dsurfaceviewofthe indexofthe sideeffectisshowninFigure9.

This study defined a new class of graph theory wherethe weighted graph is used to calculate the index of the side effect of packaged food. In this paper, the proposed model determines the amount of preservatives in packaged food and how much amount can be reduced by taking the initiative proposed herewith. By this estimation, a customer gets information about the distance between the outlet and the food factory. Every food company already provided the details of the food factory in every food packet. If the indexof side effect is given over the package, then the customer gets some extra informationin terms of numbers. In Figure 10, a new model of supplying of Haringhata Chicken is shown. It is suggested that all the outlets of Haringhata Chicken can be divided into three clusters namely C_1, C_2, $C_3$with centre at the food factory and radius r_1, r_2, r_3 such that $r_1< r_2<r_3$. These new methods suggest that as per the market demands, the production can be divided into these three clusters. The amount of preservatives will be used by some parameter like market demands, expiry date and the distance between the production factory and outlets. Thus, the amount of preservatives for an outlet in C_1 circle is less than C_2 as well as C_3. So, some people can get better quality food in C_1 circle. However, inthepresentsituation,allpacketoffoodcontainsthesameamountof preservatives.

Outlet	**Actual distance from factory**	**Index of side effect bygraph theory**	**Index of side effect by fuzzy logic**
2	2.49	0.10	6.00
3	41.1	1.64	6.00
4	38.17	1.53	6.00
5	44.21	1.75	6.00
6	12.78	0.51	6.00
7	48.61	1.94	6.00
8	93.75	3.79	6.00
9	136.68	4.21	6.00

10	152.61	9.63	9.50
11	142.88	11.31	10.00
12	147.05	13.20	10.00
13	131.05	16.32	11.32
14	219.78	19.77	13.68

Table 11: Comparison of the index of side effect of Haringhata Chicken between graph theoretical method and fuzzy logic method preservatives.

This proposed model also suggests that the amount of preservatives is added by using these parameters. The index of side effect measurement by graph theory is compared with that of a fuzzy logic system [21]. In Table 11, the index of side effect for different outlets hasbeen shown for two described method in tabular form. The samehas been shown in Figure 11. In both cases, it is seen that a variation between the two sets of data is minimal. This has been verified with the help of correlation. The correlation coefficient of the two sets of data has been calculated and shown in Table 12. The value of correlation coefficient is 0.981. This shows that the two sets are correlated. As the index of side effect measurement by fuzzy inference logic is assumed to be accurate, the index of side effect measurement by graph theory is stable as its correlation coefficient is closer to1.

Outlet	**Index of side effect by thegraph theory** (x_i)	**Index of side effect by fuzzy logic** (y_i)	$x_i-\overline{x}$	$y_i-\overline{y}$	$(x_i-\overline{x})^2$	$(y_i-\overline{y})^2$	$(x_i-\overline{x})(y_i-\overline{y})$
2	0.10	6.00	−6.492	−1.885	42.146	3.553	12.237
3	1.64	6.00	−4.952	−1.885	24.522	3.553	9.335
4	1.53	6.00	−5.062	−1.885	25.624	3.553	9.542
5	1.75	6.00	−4.842	−1.885	23.445	3.553	9.127
6	0.51	6.00	−4.652	−1.885	21.641	3.553	11.465
7	1.94	6.00	−4.652	−1.885	21.641	3.553	8.769
8	3.79	6.00	−2.802	−1.885	7.851	3.553	5.282
9	4.21	6.00	−2.382	−1.885	5.674	3.553	4.49
10	9.63	9.50	3.038	1.615	9.229	2.608	4.906
11	11.31	10.00	4.718	2.115	22.26	4.473	9.979
12	13.20	10.00	6.608	2.115	43.666	4.473	13.976
13	16.32	11.32	9.728	3.435	94.634	11.799	33.416
14	19.77	13.68	13.178	5.795	173.66	33.582	76.367
Sum	85.7	102.5	0.004	−0.005	531.343	85.359	208.891

Mean	$\overline{x}$ =6.592	$\overline{y}$ =7.885	-	**Variance**	σ_x= 6.393	σ_y= 2.562	-
The correlation coefficient is 0.981							

Table 12: Calculation of correlation of index of side effect between graph theory and fuzzy logic.

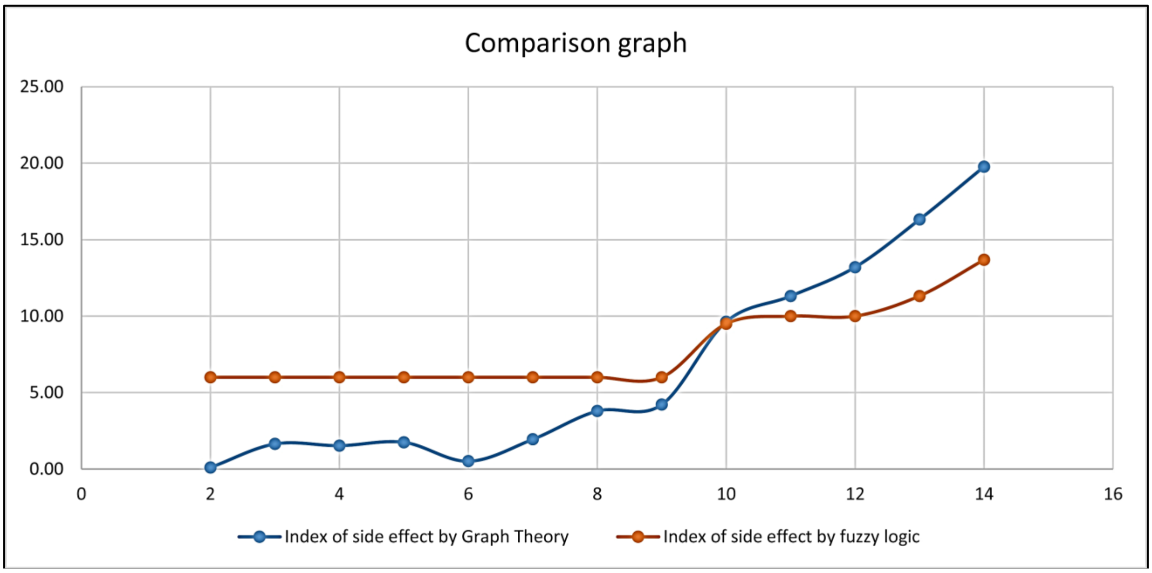

Figure 11: Comparison graph of index of side effect by graph theory and fuzzy logic

2. DISCUSSION

- The study discusses in this paper is a part of a process to reduce the amount of preservatives in packaged food, maintaining the quality of the food. The side effect of the packaged food hasbeen measured based on certain index, a customercan expect to get benefits of the packagedfood.
- Also, a process of measurement of the index of side effect by fuzzy inference logic-based system is developed.
- An extensive survey on the supply of Haringhata Chicken is also investigated. Such survey provides a comparison of our proposed model along with a fuzzy logic inference system.Thisconcludedthatourproposedmodelisstableandconvincing.

3. CONCLUSION

All the popular packaged foods are mixed by theparticular amount of organic or inorganic chemical preservative. Some of these preservatives can be very harmful to the human body. However, two studies have shown that potassium sorbate has the potential to mess with human DNA. So, the estimation for the amount of preservativesin packaged food is essential and significant. However, in the present situation, all packets of food contain the same amount of preservatives (inorganic chemical). The proposed model helps to determine the amount of chemical preservative intopackaged food using related parameters based on the fuzzy inference system.

This paper, importantly, also presents “index of side effect” for showing the hardness of usage preservative into packaged food. An in-depthsurvey on the supply of Haringhata Chicken is also conducted. For different outlets, calculation of thisindex of side effectis predicted based on fuzzy inference rule. If a neutral agency measures this index andif marked on the packaged food, then it will be easier for the customer to find the credibility for that particularquality of food. For the supplier at different outlets, this proposed model can also advise taking primitives in regulating preservative into packagedfood.

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