Mansoura University
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Measuring difference in Sensory Attributes for Eclected Pizza Dough using Duncan DMRT test: an Empirical Study on how to Rationalize Costs

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Abstract

Pizza, bread and salty assortments dough is in wide use in hotels. This dough constitute 15-20% of guests' choices in breakfast buffets and more or less around this figure in lunch and dinner buffets. Because of rising costs of ingredients, namely flour "since hotels traditionally use Italian backing flour", it is thought that a combined mixed flour dough may replace the original one and give almost the same quality of products made from the original one and yet reduce cost. To do so a control dough was prepared for pizza, bread and salty assortments and three sets of eclected combined doughs with different flour mixes. Selected items were made from all doughs and were tested by internal customers. Customers were served these items in four rounds. They were told that these items are made by different chefs and their perceptions were collected to appraise their performance and expertise in backing. A five point Likert scale was used for this and results showed one dough for pizza, bread and assortments with no significant differences in perceptions. Results also showed a significant rationalization in production cost of these items at round 14% of original costs.

Keywords: Pizza, bread and salty assortments dough, eclection "fusion", cost rationalization, sensory attributes, Duncan DMRT test.

Background

The dining experience

The dining experience in the hospitality industry is complex. This is due to the level of customer contribution in the service process (Kandampully, 1997; Parasuraman, Zeithaml, & Berry, 1985). The dining experience customer perception is intensely inclined by emotional and experiential reaction from the meeting with the service provider. The service system is refined in response to customer feedback, suggesting that service quality exists only in the perception of the customer, not in that of service providers (Kandampully, 1997). As a result, understanding customer needs about the dining experience becomes essential to the success of a restaurant business. Restaurants must attempt to provide not only quality products and service, but also attain a high level of customer satisfaction. This is very difficult in light of the varied customer demands and competitive business environment. Achieving customer enjoyment may encourage them to return to business and grant a greater market share, although a recent research has proved a weak correlation between satisfaction scores and loyalty (Van Looy, Gemmel, & Dierdonck, 1998).

On evaluating the dining experience, there is a large number of factors that lead to the guest's satisfaction including comprising both tangibles and intangibles. Kandampully and Butler (2001), elaborated that one of these factors is that of the service provided, which is an intangible as it cannot be redone or returned. Restaurant decor, appearance and amenities are the tangible elements of the experience. A study of 63 restaurants found that there was a statistically significant effect on the average guest cheque in relation to decor, including items such as open air seating, entertainment and parking (Susskind & Chan, 2000). Further, recent research has indicated that guests in restaurants link the appearance of an establishment with potential concerns about food quality (Banotai, 2003).

A review of research conducted into restaurants shows that researchers focused on many individual components of the dining experience. These include health and safety, food production, marketing, customer relations, service and

production quality (Kivela, 1997;
Lehtinen & Lehtinen, 1991; Norton, 2002; Susskind, 2002;
Svein & Trond 1992). That
showed that the dining experience is a complex one, and
that overall satisfaction relates
not to just one aspect of it.

Assessment of food quality

There are many definitions concerning food quality. Bergman and Klefsjo (1994) defined quality as driven from the Latin “qualitas” meaning “of what”. Minor and Cichy (1984) defined quality light of consumer perception. Cardello (1998) defined quality as dependent on the definition of the sensory quality. With focus on food, Jelen (1985), Fellows (1988), and Elias (2001) further divided food quality attributes as sensory and hidden non sensory attributes.

Rosenthal (1999) and Brown (2000) defined shape and general appearance as most important in assessing food quality, since they represent the first opportunity to impress the customer with the desirability of the product, and generate a primary hollow of food quality. Peckham and Freeland-Graves (1979), Hutchings (1994) referred to the prominence of color in judging the quality of food. From another viewpoint Gould (1977) and Bennion (2015) indicated that size is one of the basic visual attributes of foods since it can contribute to the perception of "wholeness" in a product. Whereas Hirsch (1990) and Fisher and Scott (1997) explicated that consumers consider flavor -including the taste and aroma- as one of the main sensory properties that is so essential and indispensable in all selection, acceptance, ingestion, and enjoyment processes of a particular food. Cardello (1998) and Brown (2000) observed that smell is almost as significant as appearance when people evaluate food item for quality and desirability. Bennion (2015), Fisher and Scott (1997) added that aroma is an important sensory attribute. Szczesniak (1990, 1998) work centered on texture as the sensory and functional manifestation of the structural and mechanical properties of foods and showed that consumers are becoming more texture-conscious. Moreover, elaborated on viscosity of some products is the most important factor to evaluate its quality, this is especially true when differentiating among sauces, soups, fruit juices, and syrups. Cardello (1998) and Brown (2000) elaborated on food sound as it can play a role in evaluating their quality, like sizzling, crunching, dripping, and crackling. Bennion (2015) and Dulen (1999) noted that food temperature is ranked as one of the top three factors that contribute to the consumers opinion of the food quality, temperature of food can greatly affect ability to taste since the human being sensitivity to taste is most intense between (20°C) and (30°C).

Evaluating food quality attributes

The Institute of Food Technologists "IFT" (1981) followed by O'Mahony (1995) defined the sensory evaluation as " a scientific discipline used to evoke, measure, analyze, and interpret reactions to those characteristics of foods and materials as they are perceived by the senses of sight, smell, taste, touch, and hearing", and explained the food evaluation types (subjective evaluation and objective evaluation). Gould (1977) and Rosenthal (1999) explained that the subjective evaluation (sensory or organoleptic tests) of food quality is based on sensory characteristics and personal preferences of selected individuals. Hutchings (1994) and Bennion (2015) reported that there are two basic types of subjective tests: Analytical tests, and Affective tests .i.e., Analytical evaluation and discriminative tests.

Moreover, The IFT (1981) and Rosenthal (1999) recommended the use of specific analytical tests like ANOVA, T-test, analysis of variance and Multiple-comparison tests, multivariate analysis of scaled data, multivariate analysis of variance (MANOVA), cluster analysis, PCA, and multi-dimensional scaling. On the other hand, Gould (1977) Bennion (2015) as well as Brown (2000) elaborated that most of the objective tests in use have been designed to measure texture, viscosity, and color characteristics of food. The objective evaluation tests include physical tests, chemical tests, and microscopic tests.

Hirsch (1990) Beckley and Kroll (1996) defined the requirements for implementing a high quality sensory evaluation. These are a) clear definition of the objectives of the sensory evaluation system, b) provision of a dedicated sensory testing environment, c) preparation and presentation of the food sample, d) selection of suitable test procedures, e) selection and training of suitable test subjects and data handling, analysis, and f) presentation (Validation).

Pizza as a popular food item

After hamburgers, pizza is the most popular fast food in the world. Forced air or natural convection with radiation are the most common baking methods. Low humidity and high processing temperatures characterize these techniques, which often result in crust formation on the pizza surface. Foods are often baked in forced convection ovens with induced air circulation. B. Hallstrom, C. Skjoldebrand, and C. Tagardh. Food Products and Heat Transfer 263 Elsevier, New York.

Eclectic “Fusion” cuisine

Norman Van Aiken, an award-winning chef and author of numerous cookbooks in the United States, coined the term "fusion" or "eclectic cuisine" (Janer,2007).

Fusion or eclectic cooking involves modifying locally available ingredients to suit their cultural preferences. Fusion cooking is a culinary technique that combines diverse regional cooking traditions to generate novel flavors. Fusion cooking is the practice of combining ingredients and culinary methods from other countries and cultures to create a flavorful dish. Fusion cuisine is the fusion of various ethnic cuisines into a single dish. Another meaning of fusion or eclectic cooking is stretching the boundaries of cooking styles by combining ethnic ingredients and techniques to create a one-of-a-kind food item that could be a snack, dessert, party meal, or full-fledged supper (Randle A., 2016). Melting, combining, mixing, gathering, and combination are all terms used by Kirim (2005) to describe fusion or eclection. Fusion cuisine, according to its originator Aiken, is the mutual interaction of territorialization and culinary know-how (Janer, 2007). Fusion cuisine, according to Uyar and Zengin (2015), is described as the creation of a new cuisine, new food, new personality, and new presentation by combining diverse senses of food from various international cuisines. The combination of different styles, techniques, ingredients, and tastes from all over the world by innovative cooks in one plate is another description for eclectic or fusion cuisine (Anon, 1996). Fusion cuisine, according to Dugdubay & Gencay (2017), is the fusion of at least two different culinary cultures on the same plate as a consequence of an intentional effort to find different or unique tastes, as long as one of the combined culinary cultures dominates the other. Fusion cuisine, according to Mil (2009), is the globalization of food through an international presentation. Fusion cuisine, according to Mohr and Hosen (2013), defies all culinary conventions and limits by removing food from culture and tradition.

Fusion cuisine has shifted to luxury restaurants in locations like London, New York, and Amsterdam, where there are numerous ethnic groups to choose from. Chefs in such establishments typically specialize in classic French and Mediterranean cuisines. Both of these cuisines' experiences have served as sources of inspiration for chefs creating fusion cuisine (Gioffre et al. 2010). It has been observed that the number of restaurants serving fusion cuisine menus around the world is growing by the day, and that many of the world's greatest restaurants have begun to include fusion cuisine methods in their menus (Scarapato & Daniele, 2003, 309 and Karamustafa et al., 2016). Although fusion or eclectic food was initially introduced in Asia, it has been noted that a large number of fusion cuisines have evolved in recent years (Dogdubay et al., 2017). (Whit, 1999) claims that in the United States, Native Americans, Europeans, and Africans have mixed culinary materials, techniques, and tastes to produce a distinct fusion cuisine. Malaysia, a multi-cultural country, has also evolved a successful fusion cuisine, according to reports (Camillo and Karim, 2014).

The primary motivation for adopting fusion cuisines

remains the same: to increase visitor happiness and loyalty (Sandikci and Celik, 2007).
Cost of food, quality, and profits kept Food quality, service quality, food safety, and hedonic value are all elements that influence how individuals choose a fine dining restaurant. One study polled 150 people with fine dining experience and proposed that a consumer economic behavior model be built using mental accounting and axiomatic design. Model correlations and the probability of each component affecting behavior were determined using linear and logistic regressions. Food quality was the most important criterion, followed by service and dining motivation, especially for family eating. Consumers are more likely to choose fine dining establishments because of safe ingredients, high cooking standards, and menu creativity. Constructing a consumption model of fine dining from the standpoint of behavioral economics, Sheng-Hsun Hsu, Cheng-Fu Hsiao, and Sang-Bing Tsai, Published: April 11, 2018, https://doi.org/10.1371/journal.pone.0194886.

Due to the highly competitive market conditions and the restaurant industry's inadequate financial structure, restaurants require effective cost control measures. According to a study, high prime costs (food costs and salary expenses) could be a serious worry for full-service restaurants, resulting in reduced profitability when compared to limited-service restaurants. Improving full-service restaurants' operational performance necessitates advanced cost-cutting abilities, such as balancing productivity and revenues while limiting quality risks. Furthermore, the size of the company had an impact because economies of scale reduced food expenses.

However, instead of depending on advertising effects to optimize revenues, management of limited-service restaurants, particularly major enterprises, should consider increasing food quality. Restaurant operational expenses and profitability enhancement, Sung Gyun Mun, (2018). Quality is often overlooked and is not the company's primary priority, despite its importance. To attract more customers, corporations, for example, place a greater emphasis on marketing aspects such as brand image or product attractiveness (Mun and Jang, 2018). Meanwhile, the company's quality development is critical as a starting point for improving the business itself, because if quality continues to improve, it will have an impact on performance and profitability (Llach et al., 2016; Menicucci, 2018; Mun and Jang, 2018).

To attract more customers, corporations, for example, place a greater emphasis on marketing aspects such as brand image or product attractiveness (Mun and Jang, 2018). Meanwhile, quality development is critical to be done by the company as a starting point for improving the business itself, because improving quality will affect performance and profitability (Llach et al., 2016; Menicucci, 2018; Mun and Jang, 2018), improved consumer facilities (Nguyen et al., 2018;Shin et al., 2019), and can further improve overall company profitability and performance (Llach et al., 2016;Menicucci, 2018. Fine dining restaurants follow a high-price consumption model; in order to persuade customers to pay a premium for fine dining, upmarket restaurants must offer relatively high utility and meet very specialized requirements, according to behavioral economics. The majority of fine dining restaurant managers fail to effectively grasp and satisfy client expectations, resulting in the exit of restaurants from the market. Consumer impressions of fine dining restaurants have altered over time from superb traditional French cuisine and world etiquette to inventive recipes, stylish décor, and a younger clientele (Harrington et al.2011).

Rick et al. questioned over 13,000 people and found that the majority of people felt anguish when they lost money. People utilize money to meet higher-level demands, despite the fact that monetary losses cause them suffering.

People, according to Hsee et al. 2009, seek happiness rather than money. It's not about how much money you spend or how much food you buy at a high-end restaurant; it's about how much satisfaction you get.

Indicating a shift in the needs of consumers. Satisfactory restaurant service, according to Jung and Yoon (2012), encourages repeat visits: Consumers with a variety-seeking orientation may want to try new things despite their restaurant's satisfaction, and hence may prefer other restaurants, demonstrating that their hedonic drive is higher than their benefits motive.

Methodology

One control dough was prepared for pizza and salty assortments and three sets of combined doughs with different flour mixes made by four pastry and backing executive chefs in Mariott hotels based on their expertise. Selected items were made from all doughs and were tested by internal customers. Customers were served these items in four rounds. The first round was for items made from control dough while the other three following rounds were for items made from other three combined doughs. One hundred internal customers were involved in these rounds. Rounds were scheduled during the same meal at the same time of the day and working schedules were updated so that the same employees will be there in the four rounds aforementioned. Internal customers were told that these items are made by different chefs and their perceptions were collected to appraise their performance and expertise in backing.

A five point Likert scale was used to test sensory attributes evaluation by internal customers. These attributes tested were (shape, color, taste, flavor and texture). A sum for weighted attributes for each dough was calculated to allow for comparison among doughs. The guiding sum was that of the control dough as usual. A comparison among sums and a t-test was carried out using SPSS version 20. Also figures showing results were drawn for easier interpretation of results.

Results and Discussion

In this part of the experiment one control dough was produced using the original recipe while three other doughs with different mixtures were also used to produce the same products, i.e., pizza and pizza dough products, bread and other relevant items. The following tables represent results based on evaluation of employees who tasted these products. The first table represents the control dough while the next three tables represent the eclected doughs. Lighting, serving temperature, serving time, cafeteria layout, table cloth colors and ambient room temperature together with attendants were the same during the three rounds of the experiment. Each round was performed during the same days of the week to make sure the same employees were present as previously explained. The following tables depicts these rounds. Sensory attributes tested were shape, color, taste, flavor and texture in the same sequence mentioned.

Table 1: Control dough rating of sensory attributes tested by employees 1st round

attribute two	1	2	3	4	5	Sum	Weighted Average
Shape	19	21	20	20	20	100	298
Color	18	21	18	20	23	100	297
Taste	19	22	17	20	22	100	273
Flavor	15	22	21	24	18	100	232
Texture	22	21	18	19	20	100	249
Sum							1349

Round 1- Control Pizza dough

As table (1) indicates candidates rated each of the sensory attribute on a scale from 1 to 5 where one represents the least value and five represents the highest value of the score. All sensory attributes were average weighted to get a total score. On summing up all sensory attributes a sum of 1349 points was obtained. This total represents the total score of the baked assortments made from the original dough and is considered as a score for the dough itself.

Table 2: composition of control dough and eclected doughs for pizza and

Pizza R1 Dough

Ingredients	%	5 K.Gs Recipe
FL 1	55%	2750
FL 2	13%	650
FL 3	13%	650
FL 4	7%	350
FL 5	12%	600
yeast	**1.25%**	**62.5**
fat	**1%**	**50**
improver	**1.25%**	**62.5**
sugar	**1%**	**50**
salt	**1%**	**50**
water	**TT**	
	5275	

Control Dough

Ingredients	%	5 K.Gs Recipe
Flour1	95%	5000
yeast	**1.25%**	**62.5**
fat	**1%**	**50**
improver	**1.25%**	**62.5**
sugar	**1%**	**50**
salt	**1%**	**50**
water	**TT**	
	5275	

Pizza R2

Ingredients	%	5 K.Gs Recipe
FL 1	**75%**	**3.75**
FL 2	**3%**	**125**
FL 3	**3%**	**125**
FL 4	**7%**	**400**
FL 5	**12%**	**600**

Pizza R3

Ingredients	%	5 K.Gs Recipe
FL 1	65%	3.25
FL 2	8%	400
FL 3	8%	400
FL 4	7%	350
FL 5	12%	600

yeast	1.25%	62.5
fat	1%	50
improver	1.25%	62.5
sugar	1%	50
salt	1%	50
water	TT	
	5275	

yeast	1.25%	62.5
fat	1%	50
improver	1.25%	62.5
sugar	1%	50
salt	1%	50
water	TT	
	5275	

Round 2- 1st Pizza eclected dough

Table 3: 1st eclected dough rating of sensory attributes 2nd round

attribute one	1	2	3	4	5	Sum	Weighted Average
Shape	21	22	27	25	5	100	363
Color	18	25	17	19	21	100	343
Taste	12	12	13	23	40	100	198
Flavor	3	7	10	38	42	100	74
Texture	11	15	24	25	25	100	188
Sum							1166

Table4 : Comparison between control sample and 1st eclected sample weighted average

attribute	R2 sample dough	Control sample dough
Shape	363	298
Color	343	297
Taste	198	273
Flavor	74	232

Texture	188	249
Sum	1166	1349

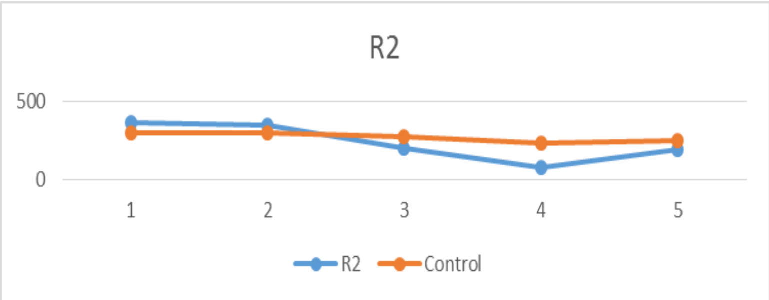

Figure 1 comparison between control sample and 1st eclected sample weighted average

Table 5: t-test of 1st eclected dough rating of sensory attributes 2nd round

<u>Difference Scores Calculations</u>

Treatment 1

N_1: 5

$df_1 = N - 1 = 5 - 1 = 4$

M_1: 233.2
SS_1: 57530.8

$s^2_1 = SS_1/(N - 1) = 57530.8/(5-1) = 14382.7$

Treatment 2

N_2: 5

$df_2 = N - 1 = 5 - 1 = 4$

M_2: 269.8

SS_2: 3406.8

$s^2_2 = SS_2/(N - 1) = 3406.8/(5-1) = 851.7$

<u>T-value Calculation</u>

$s^2_p = ((df_1/(df_1 + df_2)) * s^2_1) + ((df_2/(df_2 + df_2)) * s^2_2) =$
$((4/8) * 14382.7) + ((4/8) * 851.7) = 7617.2$

$s^2_{M1} = s^2_p/N_1 = 7617.2/5 = 1523.44$

$s^2_{M2} = s^2_p/N_2 = 7617.2/5 = 1523.44$

$t = (M_1 - M_2)/\sqrt{(s^2_{M1} + s^2_{M2})} = -36.6/\sqrt{3046.88} = -0.66$

The t-value is -2.34261. The p-value is .002685. The result is significant at $p < .01$.

As table (2) indicates candidates rated each of the sensory attribute on a scale from 1 to 5 where one represents the least value and five represents the highest value of the score. All sensory attributes were average weighted to get a total score. On summing up all sensory attributes a sum of 1166 points was obtained. This total represents the total score of the baked assortments made from the original dough and is considered as a score for the dough itself. On comparing scores between control and first dough trail a difference of 183 points was detected. When compared to the score of the original dough this difference represented 13.5% deviation from the original.

Table (3&4) display the t-test results when comparing the two samples of doughs and reveals significant difference between the two samples weher t-value is -2.34261. The p-value is .002685. The result is significant at $p < .01$.

Round 3- 2nd eclected Pizza dough

Table 6: 2nd eclected dough rating of sensory attributes tested 3rd round

attribute two	1	2	3	4	5	Sum	Weighted Average
Shape	4	8	12	30	46	100	184
Color	2	12	16	26	44	100	163
Taste	6	11	17	31	35	100	166
Flavor	17	17	13	20	33	100	193
Texture	22	21	21	20	16	100	258
Sum							**964**

Table 7 : Comparison between control sample and 2nd eclected dough sample weighted average

attribute	R2 sample dough	Control sample dough
Shape	184	298
Color	163	297
Taste	166	273
Flavor	193	232
Texture	258	249
Sum	964	1349

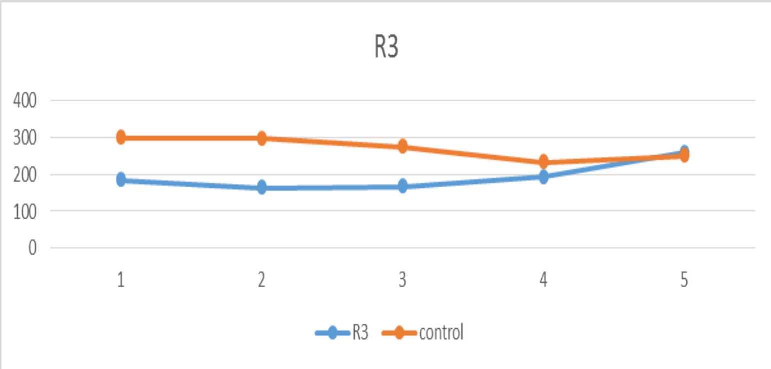

Figure 2 comparison between control sample and 2nd eclected dough sample weighted

As table (5) indicates candidates rated each of the sensory attribute on a scale from 1 to 5 where one represents the least value and five represents the highest value of the score. All sensory attributes were average weighted to get a total score. On summing up all sensory attributes a sum of 1166 points was obtained. This total represents the total score of the pack assortments made from the original dough and is considered as a score for the dough itself. On comparing scores between control and third dough trail a difference of 365 points was detected. When compared to the score of the original dough this difference represented approximately 27% deviation from the original.

Table (8): t-test of 2nd eclected dough rating of sensory attributes 3rd round

Difference Scores Calculations of t.test for R2 dough *Treatment 1* N_1: 5 $df_1 = N - 1 = 5 - 1 = 4$ M_1: 192.8 SS_1: 5934.8 $s^2_1 = SS_1/(N - 1) = 5934.8/(5-1) = 1483.7$ *Treatment 2* N_2: 5 $df_2 = N - 1 = 5 - 1 = 4$ M_2: 269.8 SS_2: 3406.8 $s^2_2 = SS_2/(N - 1) = 3406.8/(5-1) = 851.7$ T-value Calculation $s^2_p = ((df_1/(df_1 + df_2)) * s^2_1) + ((df_2/(df_2 + df_2)) * s^2_2) = ((4/8) * 1483.7) + ((4/8) * 851.7) = 1167.7$ $s^2_{M1} = s^2_p/N_1 = 1167.7/5 = 233.54$ $s^2_{M2} = s^2_p/N_2 = 1167.7/5 = 233.54$ $t = (M_1 - M_2)/\sqrt(s^2_{M1} + s^2_{M2}) = -77/\sqrt467.08 = -3.56$
Significance Level:
The *t*-value is -3.56283. The *p*-value is .003685. The result is significant at $p < .01$.
Cohen's *d* = (269.8 - 192.6)⁄4838.808597 = 0.015954.
Glass's *delta* = (269.8 - 192.6)⁄5934.8 = 0.013008.
Hedges' *g* = (269.8 - 192.6)⁄4838.808597 = 0.015954.

According to the analysis of data obtained from tables (7), t.test was made to find whether there are differences between the two samples, namely the control sample and the R2 sample. At a confidence level of 0.01 a significant difference was found between the two samples where p-value is (p=003685). To further assure the result, Cohen ‘s test value is (p=0.015954), Glass’s delta value is (p=0.013008) and Hedges’sg value (p=0.015954). All values assure the significant difference found among the two doughs inspected. The following graph shows these results.

Table (6) displays the t-test results when comparing the two samples of doughs and reveals significant difference between the two samples weher t-value is -3.56283 The p-value is .003685. The result is significant at $p < .01$.

Round 4- 3rd eclected Pizza dough

Table 9: 3rd eclected dough rating of sensory attributes tested 4th round

attribute two	1	**2**	**3**	**4**	**5**	**Sum**	**Weighted Average**
Shape	18	20	19	21	22	100	290
Color	17	22	19	20	22	100	300
Taste	19	21	18	22	20	100	276
Flavor	18	21	20	23	18	100	235
Texture	20	19	17	21	23	100	228
Sum							**1329**

As table (8) indicates candidates rated each of the sensory attribute on a scale from 1 to 5 where one represents the least value and five represents the highest value of the score. All sensory attribute were average weighted to get a total score. On summing up all sensory attributes a sum of 1329 points was obtained. This total represents the total score of the baked assortments made from the original dough and is considered as a score for the dough itself. On comparing scores between control and first dough trail a difference of only 20 points was detected. When compared to the score of the original dough this difference represented 0.0148% deviation from the original. This deviation is so minute to the point that it can be overlooked completely. To further investigate the difference t-test was made for the two samples i.e., “ control versus dough number 3”. The following table represents the results of the t-test.

Table 10: Comparison between control sample and Round 4th sample weighted average

attribute	R4 sample dough	Control sample dough
Shape	290	298
Color	300	297
Taste	276	273
Flavor	235	232
Texture	228	249
Sum	1329	1349

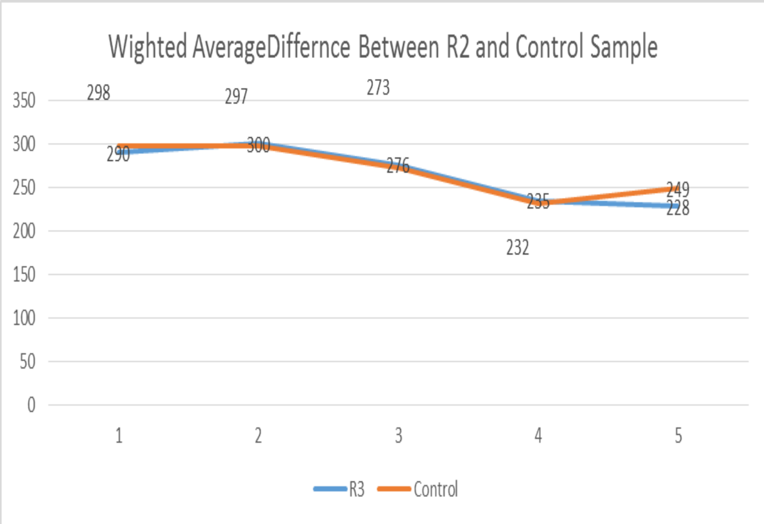

Figure3 comparison between control sample and Round 4^{th} sample weighted average

Table 11: t-test of 3^{rd} eclected dough rating of sensory attributes by employees 3^{rd} round

Difference Scores Calculations
Treatment 1
N_1: 5
$df_1 = N - 1 = 5 - 1 = 4$
M_1: 265.8
SS_1: 4236.8
$s^2_1 = SS_1/(N - 1) = 4236.8/(5-1) = 1059.2$
Treatment 2
N_2: 5
$df_2 = N - 1 = 5 - 1 = 4$
M_2: 269.8

SS_2: 3406.8 $s^2_2 = SS_2/(N - 1) = 3406.8/(5-1) = 851.7$ T-value Calculation $s^2_p = ((df_1/(df_1 + df_2)) * s^2_1) + ((df_2/(df_2 + df_2)) * s^2_2) = ((4/8) * 1059.2) + ((4/8) * 851.7) = 955.45$ $s^2_{M1} = s^2_p/N_1 = 955.45/5 = 191.09$ $s^2_{M2} = s^2_p/N_2 = 955.45/5 = 191.09$ $t = (M_1 - M_2)/\sqrt{(s^2_{M1} + s^2_{M2})} = -4/\sqrt{382.18} = -0.2$
Significance Level:
The *t*-value is -0.20461. The *p*-value is .421493. The result is *not* significant at $p < .01$.
Cohen's *d* = (269.8 - 265.8)⁄3844.265891 = 0.001041.
Glass's *delta* = (269.8 - 265.8)⁄4236.8 = 0.000944.
Hedges' *g* = (269.8 - 265.8)⁄3844.265891 = 0.001041.

According to the analysis of data obtained from table 10, t.test was made to find whether there are differences between the two samples, namely the control sample and the R2 sample. At a confidence level of 0.01 a significant difference was found between the two samples where p-value is (p=-0.20461). To further assure the result, Cohen 's test value is (p=0.001041), Glass's delta value is (p=0.000944) and Hedges's value (p=0.001041). All values assure the significant difference found among the two doughs inspected. The following graph shows these results.

Table 12: Evaluation of sensory attributes of compound pizza dough using Duncan test DMRT

Sensory attribute	control	dough compoundا
20% Shapeا	19^{a}	17^{b}
Color 20 %	18^{a}	19^{a}
Taste 20 %	17^{b}	17^{a}
Flavor 20 %	18^{b}	19^{a}
Texture 20 %	18^{a}	17^{b}
General Acceptance 100%	90^{a}	89^{a}

Shape:

It is clear from the data of table (12) that there are significant superiority of items made from (control dough) as compared to the same characteristic of items made from composite eclected dough. This is due to the fact that the bulge of the products during baking is desirable for the consumer. This took place with control dough but not perfectly in eclected dough as a result of the lack of gluten proteins in the mixed flours that were combined with the original flour in the compound eclecetd dough. In turn this resulted in loosening for gluten proteins, and eventually, is negatively reflected on the weak formation of a gluten network that was not able to reserve fermentation gases and therefore reduced ability of swell to the dough during baking, this is considered an undesirable feature for the consumer, and is consistent with findings of (Alhebeil et al., 2020).

Color:

The results shown in table (12) indicate that the color of the products made from the composite dough was superior to the color of the products made from the (control dough) although there are no significant differences at ($P<0.05$) for this characteristic, since the color of the items produced by both (18 and 19 degrees) respectively, this may be mainly due to Millard reactions between amino acids and sugar found in mixed flours used. This is consistent with (Nilufer et al., 2008., Gômez., et al., 2008). This contributed to the consumer's preference of the color of items produced by the compound eclected dough products..

Taste:

The results shown in Table (12) showed that there is no significant difference at ($p < 0.05$) in the taste of products resulting from both control and eclected composite dough, despite the increase in the flavor of products resulting from eclected dough recorded (19 degrees) versus (18 degrees) for control dough, this is mainly due to the 15% replacement of wheat flour by poor sorghum flour that resulted in a slight reduction in the amount of gluten proteins that eventually resulted in a slight insignificant decrease in the volume of baking molds, this is consistent with findings of (Alhebeil et al., 2020)

Flavor:

The results shown in Table (12) indicates that there is a significant superiority at ($p < 0.05$) of the flavor of products resulting from composite eclected dough compared to the flavor of products resulting from control dough, where the flavor of products resulting from composite eclected dough (19 degrees), while the flavor of products resulting from controlled flour (18 degrees), this significant superiority of elected dough resulted from the mix of different types flour is consistent with findings (Olaoye et al., 2016).

Texture:

The results of Table (12) indicates that there are significant differences appeared in the feature of chewing (ease of cutting with teeth and touch with the mouth) for products resulting from both composite eclected dough and (control dough), where the items produced by composite eclecetd dough scored (18 degrees) compared to control dough that scored (17 degrees), this is due to the fact that the control dough is produced by wheat flour high in its content of gluten proteins that are not dissolved in water, which gives the dough the character of elasticity, and gives the product a hard rubber texture, while compound eclected dough products made of flours containing sorghum, millet, barley and sorghum weaker types of flour is easy to cut in the mouth due to the fact that most compound flour ingredients do not contain high gluten proteins, so the replacement of 25% of them with other mixed wheat flours reduces gluten. This resulted in a decrease in the elasticity of the compound eclecteothed dough and thus became easier to cut and chew in the mouth as compared to control dough, (Bojňanská et al., 2012).

Table 13: Types and unit price of flours used in pizza and salty assortments dough

Flour type	**M. Price**	**KG M.Price**	**Percentage**	**Recipe cost**	
5 Stagioni 25 KG	900	36	**75%**	27	
Bella Napoli 10 kg	300 30	**3%**	0.75		
Caputo 25kg	750	30	**3%**	0.75	
Pevitti 50kg	900	18	**8%**	1.44	
Dnsh Egypt 50kg	400	8	**12%**	0.96	
Combined average					30.9

Total sensory qualities:

It was noted from the results of Table (12) that there was no significant difference in the sum of the sensory qualities (general acceptance) of the items produced by composite eclected dough those items produced by (control dough), where the sum of sensory attributes of composite eclected dough was (89 %) versus (88 %) of control dough, this confirms that the items produced by Composite eclected dough is highly accepted by the Control Committee.

Cost reduction

Table 12 shows the market prices for different types of flours used in combined dough whereas table 13 depicts the value of cost reduction in producing the most fitting compound dough. A saving of near 15% was achieved.

Table 14: Average combined cost and savings percentages for eclected pizza dough

Market price	Average combined dough cost	combined dough cost %	combined dough saving %
36	30.9	85.83	14.17

Implications and limitations of research

This research has a twofold implication, an academic and a professional one. In terms of academia, this research leads to better understanding of dough characters when combining different types of flour. From a professional standing point this research gave the evidence that eclection “fusion” can lead to cost reduction and rationalization aside form innovation. Despite this research adds to the body of science in terms of new compound flour doughs that can replace original dough with no significant difference in sensory attributes, however, more and above, it adds to the body of knowledge in terms of how to use eclection ”fusion” to reduce production cost without sacrificing any of food sensory qualities. From a

Conclusions

Inflation is causing food ingredients’ prices to soar. Flour prices has sky rocketed recently. This caused bread, pizza and salty assortment costs to reflect negatively on food cost of buffet. Using the expertise of four executive chefs of Mariott hotel, Cairo, Egypt, 3 compound doughs were produced and used in making items. One compound dough proved to be very similar to control dough. Items made from these different doughs were evaluated by Duncan DNTR test. The most fitting dough score was only 1% less in score than control dough at a confidence rate of $p < .01$. A significant implication of this result is that the use of newly eclected dough can lead to a drop of cost of production by 14.17%.

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