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PRE-DEGREE STUDENTS' PERCEPTIONS OF FOOD PACKAGING AND PERSPECTIVE ON NEW-GENERATION PACKAGING

Abstract: *The packaging sector has turned to new searches to offer consumers safer, higher-quality food products and to adapt to the markets. Traditional packaging is no longer sufficient. New features of food packaging are influenced by consumers' preferences for higher food safety, desire for information and convenience. New packaging systems that increase the protective power of the packaging, extend the shelf life, monitor the product, provide information about its quality and are used for product sections have emerged. This research aims to determine the perceptions of associate degree students about food packaging and their perspectives on new-generation packaging (Smart Active Packaging). The sample of the research consists of associate degree students of Namık Kemal University Vocational School of Technical Sciences. According to the results of the research, there is a statistically significant relationship between the participants' gender and various packaging preferences. The results show that associate degree students do not have detailed knowledge about innovative packaging, but they are open to training on innovative packaging. Understanding students' perspectives on packaging can help develop appropriate packaging designs for young consumers. In this context, future research can provide students with more information about innovative packaging and increase their awareness by creating personalized training programs with artificial intelligence.*

Keywords: *gender, active-smart packaging, students*

1. Introduction

Technology has become an indispensable part of our lives and affects our preferences and expectations. These developments have led food businesses to adapt to technological development. Although the task of packaging is to protect the products, its purpose and functions have changed over time. With the use of smart technologies that stand out at the point where technology has reached in the current century and the increase in interaction, an audience that

research, questions and consumes more consciously has emerged. Consumers have started to prefer hygienic, healthy and quality products among the variety of products (Öksüztepe and Beyazgül, 2015). Packaging should be able to provide better food preservation while maintaining and monitoring food quality and safety through innovative communication functions (Dainelli et al., 2008). Active and smart packaging plays a significant role in addressing the shortcomings of traditional packaging by positively impacting the shelf life, safety, quality, and security of foods

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that are crucial for both consumers and producers (Echegoyen and Nerín, 2013). Active packaging involves establishing desired interactions between food and packaging through the addition of active substances to extend the shelf life of food (Bastarrachea et al., 2011). Both active and smart food packaging provide customers with an optimal food product experience. Active food packaging aims to extend the shelf life of the product by adding certain components to the packaging (Abraham, 2022). Intelligent packaging technology is of great significance in product protection, transportation, storage, sales and consumer experience. With the continuous development of socioeconomic levels and scientific technology, smart packaging technology is more and more widely used in the market (Schaefer and Cheung, 2018). Intelligent packaging technology is a multi-disciplinary transition, multi-disciplinary integration and multi-level in-depth research system (Li et al., 2023). Smart packaging is actually a quality control system. The relationship between smart packaging technology and smart products is complementary (Yam et al., 2005).

For food packaging innovations to be commercially viable and successfully adopted by the target group, they need to meet ever-increasing regulatory requirements and have a beneficial outcome (Vanderroost et al., 2014). Artificial intelligence has emerged new food packaging materials that provide healthy food to people (Adeyomoye, 2023). Packaging-based technologies vary not only in terms of hardware but also in the amount and type of data they can generate, capture, process and distribute (Heising et al., 2014). Modern food technology has brought about intelligent food packaging, which includes sensors, indicators, data carriers, and artificial intelligence (Abekoon et al., 2024). In general, smart packaging technology has a wide variety of potential application fields (Arvanitoyannis and Stratakos, 2012). From a customer perspective, such opportunities

are perceived as value-added benefits. In this day and age of people being permanently connected to the Internet, new ways of tracking and monitoring purchased goods with associated apps have turned into an important business opportunity for companies to increase customer satisfaction and loyalty (Schaefer and Cheung, 2018). Active packaging involves the interaction between the product, packaging, and the environment (Biji et al., 2015; Dobrucka and Przekop, 2019). It aims to extend shelf life, preserve nutritional and organoleptic quality, prevent the growth of pathogenic and spoilage microorganisms, and hinder the migration of pollutants (Altan et al., 2018; Guo et al., 2014; Sohail et al., 2018). Active packaging is the first method that replaced conventional packaging techniques. This engineering marvel involves incorporating bodies into packaging that can absorb or release desired substances from or to the product, maintaining both visual and chemical quality (Arvanitoyannis and Stratakos 2012). However, these techniques are only applicable in the industry if accepted by consumers (Siegrist, 2008). An alternative method to ensure the safety of food items is through effective food packaging systems, as consumers demand better quality and taste (Steenis et al., 2017). If the packaging does not carry any additional information for the buyer, other than printed information about the composition of the product, it loses the meaning of being innovative (Kocetkovs et al., 2019). Intelligent packaging system uses communication functions (Ghaani et al., 2016). It is capable of carrying out intelligent functions such as sensing, detecting, tracing, recording and communicating certain types of information (Realini and Marcos, 2014). The integration of AI into intelligent food packaging is composed to become even more sophisticated, enabling real-time monitoring and decision-making. This opens up an exciting area of possibilities where packaging can adapt and respond to

changing environmental conditions and consumer preferences. (Abekoon et al., 2024). Packaging technology is very open to integration. The availability of smart packaging to control the effectiveness of active packaging systems is the most concrete evidence of this (Kerry et al., 2006). Considering the benefits of smart and active packaging technologies, the integration of the two technologies in the packaging of a food product can provide a synergistic effect on food safety and quality (Vanderroost et al., 2014). The innovations in packaging should be commercially viable and embraced by the target audience. When the next generation of packaging is supported by artificial intelligence, the processes for extending the shelf life of food can be optimised, and they can be managed with more precision and efficiency. This could enhance food safety and improve the consumer experience.

2. Materials and methods

The data for the study were obtained through surveys conducted with associate degree students at Namık Kemal University Technical Sciences Vocational School. In the survey administered voluntarily, questions were included to determine demographic characteristics, general expectations related to food packaging, and questions related to next-generation packaging. To represent associate degree students in the best possible way, 300 students enrolled in 20 programs across 10 different departments (15 students from each program) were interviewed. The preliminary trial of the study was carried out in October 2022 by performing 10% sampling and the validity of the questions was tested by making corrections when necessary (Badrie et al., 2004). To have effective communication, the questionnaire was distributed to the participants in small groups covering the months of November 2022 and December 2022 and they were asked to answer. The survey questions were arranged

by the purpose of the research by examining the literature (Aday and Yener, 2015; Nosáľová et al., 2018; Li et al., 2020; Cammarelle et al., 2021; Kocetkovs et al., 2019).

2. 1. Statistical Analysis

The descriptive statistics of the data obtained from the research were evaluated through Crosstabs analyses using Chi-square (χ^2) independence tests in the SPSS ver.18 statistical package program (Gujarati, 1995; Mirer, 1995).

2.2. Research Limitations and Originality

The limitation of this study is that it was conducted only on associate degree students at Namık Kemal University, Technical Sciences Vocational School, and the findings may not apply to other associate degree students. Our study can raise awareness about innovative packaging technologies among associate degree students and facilitate the adoption of these technologies.

3. Results and Discussion

Among the participants in the survey, 77% were male, while 23% were female. It was determined that most students (60.4%) were in the 18-20 age range. It was determined that 2.3% of the associate degree students were at the undergraduate level 94.7% of the participants were single and 5.3% were married. According to the accommodation type while receiving an education; 41% of the students were with their families, 39.3% were in the dormitory hostel, 19% were at home apart from their families and 0.7% were with others. Demographic characteristics determine the features individuals look for when purchasing a product (Durmaz et al., 2011).

Table 1 provides the reasons for students' preference for packaged products based on gender.

Table 1. Reasons why students prefer packaged products by gender (%)

Gender	The reason for choosing packaged products			Statistics
	Quality	Hygienic	Reliable	
Male	17.3	48.9	33.8	$\chi^2 = 6.909^*$ Cramer's $v=0.152$
Woman	7.2	65.2	27.5	
General	15.0	52.7	32.3	

*There is a significant relationship at $P<0.05$ level.

A relationship was found between gender and preference for packaged products. 65.2% of women and 48.9% of men preferred it because it was hygienic. In general, a significant 52.7% preferred packaged food because it was hygienic, 15% because it was of good quality, and 32.3% because it was reliable. Consumers don't purchase packaging; they purchase food products that happen to have packaging built into the product offering (Young et al., 2020). In a conducted study, it has been determined that consumers largely prefer packaged products

because they perceive them to be healthier (Dilber et al., 2012). Individuals have been exposed to different information windows and product varieties; numerous alternatives and options in the market influence purchase decisions. However, interpretation and decision-making vary among individuals and are also influenced by internal consumer behaviour and external factors (Mousavi and Jahromi, 2014). In Table 2, the determinant role of packaging in food selection is presented based on gender.

Table 2. The determining role of packaging in food choices according to gender (%)

Gender	The determining role of packaging in food choices			Statistics
	Yes	No	Sometimes	
Male	32.0	14.7	53.2	$\chi^2 = 6.024^*$ Cramer's $v=0.142$
Woman	26.1	5.8	68.1	
General	30.7	12.7	56.7	

*There is a significant relationship at $P<0.05$ level

The relationship between gender and the determinant role of packaging in food choices has been identified. More than half of both female and male participants have indicated that packaging is sometimes a decisive factor in food choices. Despite factors such as new technology or material development, the preferences and wishes of

the consumer are important elements that drive the marketing process. Therefore, the fundamental issue for packaging design is to understand the consumer (Stewart, 2004).

The distribution of how leftover food is stored after opening the package, based on gender, is presented in Table 3.

Table 3. Distribution (%) of how the remaining food after opening the package is stored based on gender.

Gender	The way to store the remaining food after the package is opened			Statistics
	Original packaging	Plastic bag	Another container	
Male	38.1	20.8	41.1	$\chi^2 = 17.247^{**}$ Cramer's $v = 0.240$
Woman	20.3	10.1	69.6	
General	34.0	18.3	47.7	

**There is a significant relationship at $P<0.01$ level.

When the entire food is not consumed, participants indicated that 34% of them store the remaining portion in its original packaging, 18.3% cover it with a plastic bag on the original packaging, and 47.7% transfer it to another lidded storage container (glass or plastic). In the study conducted by İstanbullugil et al. (2019) it has been

observed that university students pay the most attention to the expiration date, shelf life, price, weight, and storage instructions when purchasing food items.

The distribution of the preferred method for extending the shelf life of food, based on gender, is provided in Table 4.

Table 4. Distribution (%) of the preferred method for extending the shelf life of food based on gender.

Gender	The preferred method to extend the shelf life of food			Statistics
	Additive	Hormone	Innovative package	
Male	13.4	9.1	77.5	$\chi^2 = 9.488^{**}$ Cramer's v= 0.178
Woman	7.2	0.0	92.8	
General	12.0	7.0	81.0	

**There is a significant relationship at $P < 0.01$ level.

The majority of students prefer innovative packaging methods to extend the shelf life of foods. It was found that women preferred innovative packaging methods to extend the shelf life of foods more than men. None of the female participants preferred the addition of hormones. In the study conducted by Aday and Yener (2015), 7.67% of the participants preferred to use food additives, 5.21% preferred to inject hormones and 87.12% preferred to use innovative food packaging technologies to extend the shelf life of foods. In their 2010 study, Mahalik and Nambiar (2010) stated that more reliable food packaging can be produced with new technologies. 19.7% of the students who participated in the survey indicated that they had prior knowledge about innovative

packaging methods, while 80.3% stated that they did not know about them. In a study by Barska and Wyrwa (2016) investigating consumers' perceptions of active and intelligent packaging, they found that only 17% of the participants were familiar with the term smart packaging. In their study, Stoma and Dudziak (2022) pointed out that the level of knowledge about the essence of smart and active packaging is still low. A study has determined that the awareness of smart packaging innovations among customers in Slovakia is at a low level (Loučanová et al., 2022).

The importance of health-related preferences in packaging, based on gender, is provided in Table 5.

Table 5. Gender-based importance (%) of health-related demands in packaging.

Gender	Order of importance of health-related demands in (1 lowest -5 highest)					Statistics
	1	2	3	4	5	
Male	5.6	3.9	14.7	16.9	58.9	$\chi^2 = 10.914^*$ Cramer's v=0.191
Woman	1.4	1.4	4.3	14.5	78.3	
General	4.7	3.3	12.3	16.3	63.3	

*There is a significant relationship at $P < 0.05$ level.

In our study, a relationship has been identified between gender and the degree of importance placed on health-related demands in packaging. It has been determined that women place a higher degree of importance on health-related demands in packaging compared to men. It has been reported that female consumers are more wary of new technologies due to their

nurturing and caregiver roles within the family (Chen et al., 2013). Consumers' choices and the organization of product purchase information influence each other (Alba and Hutchinson, 1987).

The importance of environmentally-related preferences in packaging, based on gender, is presented in Table 6.

Table 6. Gender-based importance (%) of environmentally-related demands in packaging.

Gender	Order of importance of environmental demands placed in (1 lowest -5 highest)					Statistics
	1	2	3	4	5	
Male	5.2	6.5	19.0	22.9	46.3	$\chi^2 = 9.870^*$ Cramer's $v=0.181$
Woman	1.4	1.4	11.6	20.3	65.2	
General	4.3	5.3	17.3	22.3	50.7	

*There is a significant relationship at $P < 0.05$ level.

In our study, it has been determined that women (65.2%) place a higher degree of importance on environmentally-related demands compared to men (46.3%). The findings from the study by Prakash and Pathak (2017) indicate that the intention to purchase environmentally friendly packaging is significantly influenced by personal norms, attitudes, environmental concerns, and willingness to pay. Mancini et al. (2017) stated in their study that consumers pay little attention to the information given on the label for sustainable food consumption and environmental protection and have little information about environmental problems. The study by Barber et al. (2014) indicates that the majority of consumers are unwilling

to pay more for environmentally friendly products. In the study by Lindh et al. (2016) it was stated that 60% of consumers consider the environmental impact of packaging to be moderate to highly important when selecting food products, and 86% are willing to make an extra payment for environmentally sustainable packaging. Worldwide research results indicate the importance of ecological and sustainable development issues for consumers when it comes to the packaging of food products (Licciardello, 2017; Tiekstra et al., 2021).

The importance of product-related demands (quality-price) in packaging according to gender is given in Table 7.

Table 7. Importance of product-related demands (quality-price) in packaging by gender (%).

Gender	The importance of demands related to the product in the packaging (1 lowest -5 highest)					Statistics
	1	2	3	4	5	
Male	5.6	4.8	15.2	19.9	54.5	$\chi^2 = 10.043^*$ Cramer's $v=0.183$
Woman	0.0	1.4	8.7	17.4	72.5	
General	4.3	4.0	13.7	19.3	58.7	

*There is a significant relationship at $P < 0.05$ level.

The relationship between gender and the importance of product-related demands in packaging has been identified. Women have shown a higher level of importance for product-related demands compared to men.

Food packaging also defines the quality of the product. (Geambasu, 2017). Consumers consider cost, safety and quality in their purchasing decisions (Dagevos and van Ophem, 2013). Especially in developing

countries, price takes precedence in product preferences, particularly in food products (Saygin and Demirbaş, 2018).

The importance of packaging reuse by gender is given in Table 8.

Table 8. Importance of packaging reusability by gender (%).

Gender	Order of importance of reuse of food packaging (1 lowest -5 highest)					Statistics
	1	2	3	4	5	
Male	9.1	11.3	19.5	19.5	40.7	$\chi^2 = 12.281^*$ Cramer's $v=0.202$
Woman	0.0	5.8	15.9	31.9	46.4	
General	7.0	10.0	18.7	22.3	42.0	

*There is a significant relationship at $P < 0.05$ level.

The relationship between gender factors and the importance of packaging reuse has been identified. Reusability has been generally evaluated as follows: 7% rated it as first-degree important, 10% as second-degree, 18.7% as third-degree, 22.3% as fourth-degree, and 42% as fifth-degree important. The packaging that keeps the product fresh for a longer time, can be opened and reclosed, refillable, and reusable, is rapidly taking its place on the shelves (Gürbüz and Kadağan, 2022). In the study by Babader et

al. (2016), it was found that consumers have very little information about the reuse of packaging. Using packaging repeatedly for other purposes after purchase refers to sustainable consumption, environmental management, and green consumption, as it leads to less environmental pollution (Üstündağlı and Güzeloğlu, 2015).

The distribution of the most important factor in innovative packaging by gender is given in Table 9.

Table 9. The most important factor in innovative packaging by gender (%).

Gender	The most crucial factor in innovative packaging			Statistics
	Unique aroma	Maintain color	Preventing microbial spoilage	
Male	35.5	10.4	54.1	$\chi^2 = 8.816^*$ Cramer's $v=0.171$
Woman	21.7	4.3	73.9	
General	32.3	9.0	58.7	

*There is a significant relationship

In our study, it has been emphasised that women (73.9%) consider preventing microbial spoilage to be a more crucial factor in innovative packaging compared to men (54.1%). In general, 32.3% indicated that preserving the unique aroma of the food is crucial, 9% emphasised the importance of preserving the colour of the food, and 58.7% highlighted the significance of preventing microbial spoilage. The development of packaging relies on intentional interaction with food, minimising undesirable changes while directly enhancing food quality and safety (Vasile and Baican, 2021). Packaging is a crucial stage in the food production

process as it preserves the quality of food during storage, transportation, and until the point of consumption (Ambaw et al., 2021). To the question 'Which feature is most important to you in an innovative package?'; 16.3% inform customers about the history of food, 47.7% inform customers about the freshness of food, 12% inform customers about possible unwanted small tears/holes in the package, 7% of the customer of the food product to inform customers whether it is hot or cold, 17% stated that it is to inform customers about whether there are toxic compounds in food. The main purpose of product evaluation is to help consumers

make the right decisions. Traceability helps consumers evaluate the quality and performance of the product or achieve a genuine product feel (Daoud and Trigui, 2019).

Marketing communications, including advertising, promotion, branding, nutrition, and health claims, can influence a consumer's expectations of the sensory and nonsensory benefits of the food (Chandon and Wansink, 2012). What would be your reaction if a brand you trust handed out a sample of free food packaged with innovative packaging to see the difference between innovative packaging and regular packaging? I do not consume 19% to the question, I consume 37.7%, 16% I take it but I consume it with suspicion, 27.3% If there is enough information about the method, I can decide accordingly. It was determined that the respondents were open to innovation

and were ready to try it, even if they were cautious. Promotions, introductions, and advertisements conducted on products attract the consumer's attention and arouse curiosity (Düz, 2012). The food and packaging industry is seeking new techniques and approaches to meet the demands and needs of consumers. However, not all innovative food technologies are equally accepted by consumers (Siegrist et al., 2007). It is noted that this is primarily due to fears, concerns, distrust, and misunderstandings related to the nature of technology (Behrens et al., 2009). However, the application and success of these techniques depend on the consumer's acceptance of innovation (Siegrist, 2008) and their behavioural responses to innovation (Chen et al., 2013).

The distribution of the first information sought before consumption of food packaged with innovative packaging by gender is given in Table 10.

Table 10. Distribution (%) of the first sought information before consumption in food packaged with innovative packaging, by gender.

Gender	What is the most important factor in innovative packaging					Statistics
	Simple knowledge	Method information	Government approval	Trusted brand	Health information	
Male	22.5	20.8	28.6	12.6	15.6	$\chi^2 = 10.821^*$ Cramer's $v = 0.190$
Woman	15.9	18.8	17.4	17.4	30.4	
General	21.0	20.3	26.0	13.7	19.0	

A statistical relationship has been identified between gender and the first sought information before consumption in food packaged with innovative packaging. If you notice the label 'prepared with innovative packaging method', what information would you look for first on the packaging before taking it home? 21% reported simple information explaining the method, 20.3% detailed information about the method, 26% information about whether it was approved by official institutions, 13.7% reported whether sales were made under reliable brands and 19% reported information about what it could lead to in terms of health. The packaging materials and information displayed on packaging influence consumer

expectations and willingness to purchase (Koutsimanis et al., 2012; Rebollar et al., 2017).

Consumer knowledge is a crucial factor in consumer decision-making (Pieniak et al., 2013). In a study, it was determined that women are significantly more involved in food than men and pay much more attention to informative cues when choosing food to control their weight (Vila-López and Kuster-Boluda, 2016). Information about new technology can help increase consumer acceptance. Consumers take innovative food packages home and start trying them if they are drawn to the label that says 'prepared with an innovative packaging method' (Chen et al., 2013).

In our study, after seeing the positive impact of innovative packaging, 41.7% of the participants stated that they would not buy if the price was higher than traditional packaging, 46.7% would accept a price increase of less than 10%, 10.3% would accept a price increase between 11-40%, and 1.3% would accept a price increase of more than 41%. It was determined that a significant part of the students surveyed are inclined to try modern packaging technologies, although the desire to buy safer and higher quality products is relatively more expensive than traditional technologies. A study was conducted on consumer awareness and attitudes towards active and smart packaging systems in the Latvian market. 32% (average in Latvia) and 56% (in Riga) of respondents are willing to buy such products, with data showing that consumers are open to wider use of innovative packaging for food packaging (Kocetkovs et al., 2019). Research by Irish scientists found that Irish consumers are not willing to pay more for smart packaging, but the willingness to pay more for smart

packaging increases after participants are informed about the value of using such technologies (O'Callaghan and Kerry, 2016). In another study, consumers expressed their willingness to pay more for packaging that extended the shelf life of freshly cut vegetables and indicated a desire to see new types of packaging, such as smart packaging (Wilson et al., 2018).

If satisfied after experiencing food packaged with innovative packaging 88.3% said they would recommend it to others, while 11.7% would not recommend it. Consumer behaviour is the study of the processes by which individuals or groups select, purchase, use, or dispose of products, services, ideas, or experiences to satisfy needs and desires (Ampuero and Vila, 2006). Packaging preferences can be significantly influenced by consumer feedback (Boz et al., 2020; Otto et al., 2021).

The distribution of the preferred information method about innovative packaging by gender is given in Table 11.

Table 11. Distribution of the preferred information method for innovative packaging by gender (%).

Gender	The preferred method of information about innovative packaging				Statistics
	Television	Social media	Conference-symposium	Written brochure	
Male	21.6	59.7	7.8	10.8	$\chi^2 = 1.644^{**}$ Cramer's $v = 0.197$
Woman	26.1	49.3	20.3	4.3	
General	22.7	57.3	10.7	9.3	

**There is a significant relationship at $P < 0.01$ level.

'If you were informed about innovative packaging, which way would you choose?' 27.7% preferred television programs, 57.3% preferred social media, 10.7% preferred conference-symposium and 9.3% preferred written brochures. A knowledgeable consumer acquires information about food from various available sources and compares it with the information on food product labels (Bialkova et al., 2016; Andrews et al., 2011). Today's consumers are the people who grew up in a digital era. Platforms for

interaction have been developed by modern technology, and they are becoming increasingly significant in consumer behaviour (Jacobsen et al., 2021). Consumers can utilise interactive communication technologies to communicate with food companies about product issues or ideas (Siddiqui et al., 2022).

4. Conclusion

The results show that associate degree students do not have detailed information about innovative packaging, but they do not reject innovative packaging technology and are open to education about it. 65.2% of women and 48.9% of men have preferred packaged food because it is hygienic. Hygienic packaging preferences can lead to an enhancement of hygiene standards in packaging designs and manufacturing processes. The majority of students who participated in the survey generally prefer innovative packaging methods to extend the shelf life of food. This preference may encourage the development of more durable and longer-lasting products in the industry. It has been determined that women place a higher degree of importance on health-related demands, product-related demands (quality-price) and environmentally-related demands compared to men. Environmental and health-related demands can guide the industry towards sustainable packaging materials and pricing strategies. At a time when gender and health preferences are becoming increasingly important in packaging, AI can help companies gain a competitive advantage by making these processes more efficient and effective. A significant number of students stated that a price increase in innovative packaging could be a problem. However, after observing the positive effects of innovative packaging, it has been determined that the majority would accept a price increase. The analysis, prediction and personalisation capabilities offered by artificial intelligence can be used

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to optimise quality and price, increase satisfaction and provide a competitive advantage.

The majority of their students indicated that if they were satisfied after experiencing food packaged with innovative packaging, they would recommend it to others. High levels of satisfaction and sharing of positive experiences can lead to the adoption of innovative packaging. More than half of the participants preferred social media as the method of being informed about innovative packaging. Artificial intelligence is a powerful tool to support students' adaptation to technology, to understand the preferred information methods for innovative packaging by gender, and to provide the best access to this information.

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Statement of Researchers' Contribution Rate

Authors declare that they will contribute equally.

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