OPTIMIZATION OF SWEET EGG SPREAD FORMULATION: IMPACT OF EGG YOLK POWDER ON TEXTURE, FLAVOR, AND STABILITY

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ABSTRACT

The consumption of bread spreads has seen a significant rise in recent years, prompting the creation of an innovative product known as Sweet Egg Spread. The study has led to the development of Sweet Egg Spread, a versatile product available in five distinct flavors: Chocolate, Pineapple, Strawberry, Mango, and Vanilla. Also, evaluates the physical and chemical properties of the spread, including moisture content, water activity, ash content, and fat percentage, which are found to be consistent across different flavors. Among these, the Chocolate and Pineapple flavors exhibit exceptional sensory qualities. Notably, the use of egg yolk powder in the formulation significantly enhances the product's texture, flavor, and stability compared to liquid egg yolk. This study highlights the development of a high-quality, egg-based spread that meets the increasing demand for convenient and various food products. Sweet Egg Spread stands out for its excellent sensory properties, consistent quality, and wide range of applications, making it a valuable addition to various culinary creations.

Keywords: *Egg yolk powder, ready-to-eat, egg yolk liquid, flavors, egg-based product*.

INTRODUCTION

Egg yolks are often overshadowed by their counterpart, that is Egg white which holds a wealthy nutritional profile (Herron & Fernandez, 2004; Kechil et al., 2017). The yolk presents a sophisticated hierarchical structure, comprising insoluble protein clusters known as granules, suspended within a translucent yellow fluid referred to as plasma (Ruxton et al., 2010). This plasma contains a mix

of low-density lipoproteins (LDL) and soluble proteins (Guérin-Dubiard et al., 2007). These Egg yolks are rich in vitamins, minerals, and essential fatty acids (Song & Kerver, 2000). Its vibrant yellow color indicates high content of carotenoids, antioxidants that help in promoting the overall well-being of human health (Tang et al., 2019). Beyond its nutritional profile they have exceptional culinary benefits that help in enhancing the overall flavor of the food(Juneja & Kim, 2018). These egg yolks have creaminess, richness, and emulsifying properties that help improve the texture of the food (Antón & Gandemer, 1997). In our project we are trying to incorporate this texture and flavor into a spread which is a versatile food that has the flavor and texture (Anton, 2007). A spread is a food item that is spread over items like bread and crackers, usually using a knife. Spreads are used in food to improve its flavor or texture (Asghar & Abbas, 2012a). Typically, the spread is made using butter, milk, sugar, and extra flavoring. Spreads are great as party food, snacks, and condiments. Nevertheless, they can occasionally contain a lot of added sugar, salt, and other high-calorie components. By using important motivators like ongoing product innovation, the new brands are giving the more established one's fierce competition. Spreads are a crucial component of a typical breakfast in the West, and the spread market is expected to increase significantly because of these developments in other regions.

The current project intends to develop five different flavors of Sweet Egg Spread, an egg-based product, coupled with butter, powdered sugar, and skim milk powder for use in the creation of ready-to-eat products using an electric mixer. In addition to being a dessert topping, sweet egg spread can be used as a filling for macaroons and other sandwich cookies, a tart, a cream pie, or in between cake layers. For each of the five distinct flavor variations chocolate, pineapple, strawberry, mango, and vanilla. This study aims to create a product made of eggs.

MATERIALS REQUIRED

The ingredients used for this study are Egg Yolk Powder which is spray dried and other ingredients like Powdered Sugar, Skim Milk Powder, Butter, Cocoa syrup, Different Flavored Powders (Spray dried Strawberry, Pineapple, Mango), Different flavored essence (Strawberry, Pineapple, Mango, Vanilla, Chocolate) were brought from the food graded retail shop from Coimbatore.

METHOD OF PREPERATION

The eggs are cracked first, followed by the separation of the yolk and albumin. The solution is eventually filtered and stored in a tank. The eggs are pasteurized and then spray-dried. The powder

is subsequently packaged and stored. Trials were carried out to determine the quantity of substances used.

Table:1 Ingredients composition of Preparation of egg spread

S.NO	INGREDIENTS	FLAVOR 1 (%)	FLAVOR 2 (%)	FLAVOR 3 (%)	FLAVOR 4 (%)	FLAVOR 5 (%)
1	Egg Yolk Powder	15	15	15	15	15
2	Powdered Sugar	30	30.5	31	31.5	32.5
3	Skimmed Milk powder	15	17	18.5	19.5	20
4	Butter	5	5	5	5	5
5	Water	25	25	25	25	25
6	Flavours (Spray Dried Powders and Cocoa Syrup)	10	7.5	5	3.5	2.5
7	Flavours (Essence)	0.1	0.1	0.1	0.1	0.1

Each flavour preparation's ingredients are weighed and combined. Water is added to the mix and thoroughly mixed for 5 minutes using an electric beater. Following this, the desired flavour is added, such as cocoa syrup for chocolate, pineapple essence for pineapple, strawberry essence for strawberry, mango essence for mango, and vanilla essence for vanilla. Butter is added and thoroughly mixed. The item is then packaged and kept. Then different procedures were carried out to find the different properties of the spread.

Physical properties:

Viscosity and consistency were assessed using a Brookfield viscometer and Bostwick Consistometer, respectively. While no discernible variance was observed in viscosity and consistency among all flavoured spreads, the mango flavoured spread exhibited a slight watery consistency compared to others (Orishagbemi et al., 2017).

Moisture Content:

Precisely measure 5 grams of the sample and transfer it into a Stainless-steel cup with a previously dried and weighed cover. Place the dish with the material in an oven set at 100 ± 2˚C for approximately 5 hours, ensuring it remains uncovered during heating. Allow the sample to cool within a desiccator before reweighing it with the cover on (Koc et al., 2011).

Water Activity:

The analysis was conducted using the AQUALAB water activity-meter, operating based on the principle of dew point Prior to use, the instrument underwent calibration using supersaturated solutions of lithium chloride (8.57M) and sodium chloride (6M) according to AOAC standards (2005). All flavoured spreads exhibited similar water activity values, with no discernible differences observed among them (Chudy, Pikul, Rudzinska, et al., 2015).

Ash Content %:

Precisely measure approximately 3 grams of the material into the dish, which has been previously dried in an air-oven and weighed. Subsequently, subject the dish to heat initially on a Bunsen burner, followed by placement in a muffle furnace set at 550±10˚C for a duration of 4 hours until grey ash is obtained. Allow the dish to cool within desiccators before conducting the weighing procedure (Rannou et al., 2015).

Fat Content:

Accurately weigh approximately 2 grams of the sample into Whatman Cellulose thimbles (30 X 100mm) and subject them to extraction with chloroform for a duration of 4 hours using a Soxhlet extractor. Following extraction, remove the chloroform by distillation and disconnect the Soxhlet flask. Place it in an oven set at 100± 2˚C for a period of 4 hours. After oven treatment, allow the flask to cool within a desiccator, then proceed to weigh it to determine the fat percentage, as per standard procedures (Chudy, Pikul, Rudzinska, et al., 2015).

Total Soluble Solids:

The ERMA PORTABLE REFRACTOMETER (28-62 DEGREE BRIX) was utilized for analysing Total Soluble Solids (T.S.). A small portion of the product was placed beneath the cover plate, which was then closed securely.

The measurement was obtained by positioning the refractometer to allow direct light exposure onto the sample, with the reading recorded in degree brix. All flavoured spreads exhibited similar Total Soluble Solids (TSS) percentage values, with no discernible differences observed among them (Koc et al., 2011).

RESULTS AND DISCUSSION

Physical properties:

These are the results of the viscosity and the consistency that we got for our product. From this result we see that the chocolate flavoured spread has high viscosity whereas the mango flavoured spread has high consistency. These changes are due to the different types of flavours that is been used and due the changes in properties when the mixed (Sanusi et al., 2020).

Moisture Content:

As for the moisture content we can see a slight difference in the Moisture Content between flavours. From this we can see that the moisture content of the chocolate flavoured spread is comparatively low are processed with certainly high temperature than other spreads. We can also conclude that the shelf life of this flavour is higher than the others (Fu et al., 2020).

Table:2 Results for Physio-chemical parameters

FLAVORS	VISCOSITY (cp)	CONSISTENCY (cm/min)	MC (%)	a_w	Ash %	Fat %	TSS%
Chocolate flavored spread	57960	10	40.50	0.586	0.65	10.20	60
Pineapple flavored spread	57650	10.2	41.62	0.615	0.70	10.65	61
Strawberry flavored spread	57860	10	40.98	0.610	0.68	10.60	60.5

Mango flavored spread	56980	10.3	41.64	0.645	0.69	10.50	60.5
Vanilla flavored spread	57440	10.1	41.24	0.625	0.72	10.98	61

Water Activity (a_w):

We already know that the moisture content is low which will result in low water activity. So, the chocolate flavoured spread has low water activity which help in controlling the microbial growth and enhancing the shelf life. As the result of low $\mathbf{a_w}$ we can store it for longer time (Obara et al., 2006).

Ash Content %:

Ash content indicates the amount of minerals that is present in the food material. Here we can see the ash content is high in vanilla flavoured spread and is low in the chocolate flavoured spread. There is not much difference in the ash content ash they are natural fruit essence. Vanilla has high ash content as the have flavouring agents and stabilizers which contribute to the mineral composition (Asghar & Abbas, 2012b).

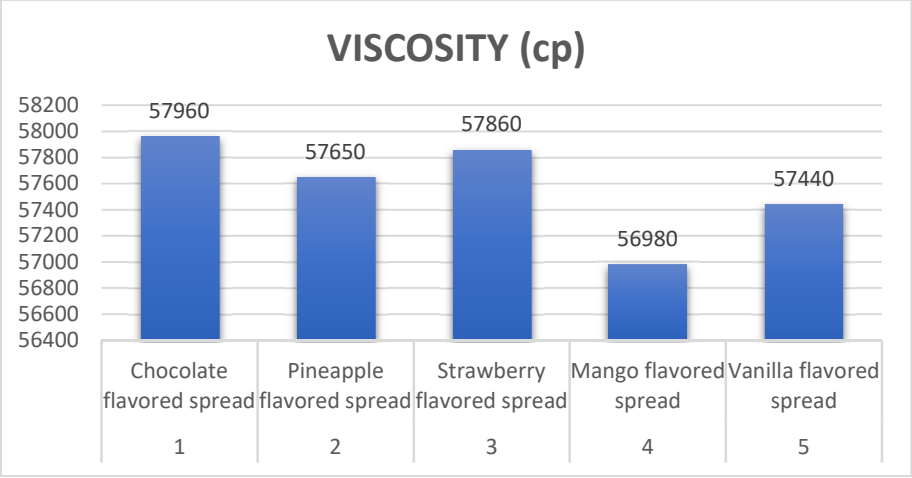

Fig:1 Viscosity of distinctive egg spread Flavors

Fat Content (%):

Fat content plays one of an important role for the texture of the food material. Here we can see amount of fat content that is found out by Soxhlet method. The fat content in the vanilla is higher

as they are made by adding vegetable oils which gives them high fat composition compared to others. Vanilla spread also have emulsifiers which have fat content (Caboni et al., 2005).

Total Soluble Solids:

Total soluble solids describe the concentration of solids dissolved in the liquid. From our research we came to know that there is not much difference in the TSS. This shows that our samples have similar Total Soluble Solids (Martinet et al., 2003).

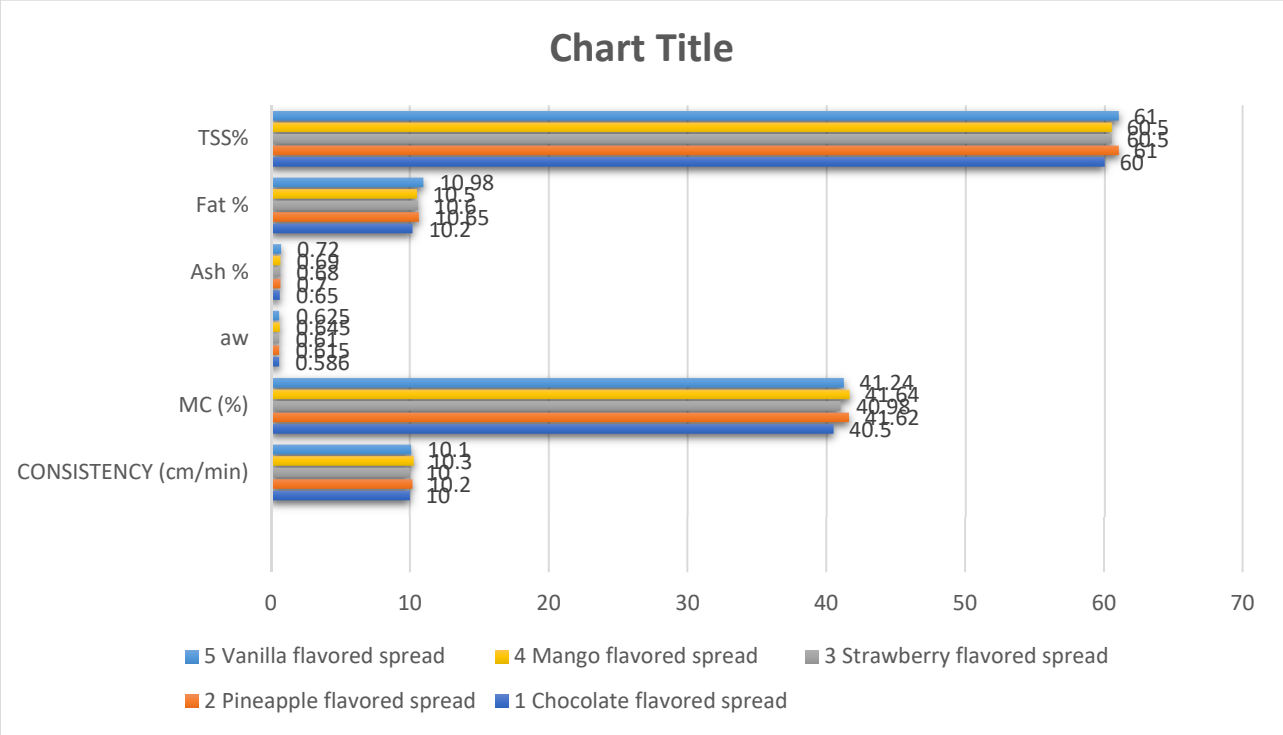

Fig:2 Graphical Representation of Results for flavoured egg spreads

Microbial Analysis:

Under storage conditions at 4°C (chiller), no microorganisms were observed, and no counts were recorded during the 45-day testing period of samples. Similarly, under ambient conditions, no microorganisms were detected, and counts remained absent throughout the 45-day testing period. However, upon opening the storage container, shelf life was observed to decrease, leading to the formation of microorganisms (Chudy, Pikul, & Rudzińska, 2015; Le Denmat et al., 1999; Lechevalier et al., 2013).

Table:3 Microbial Analysis of egg spread

S.NO	PARAMETERS	LIMIT
1	Total Plate Count (cfu/g)	≤10
2	Coliform (cfu/g)	Absent
3	Enterobacteriaceae (cfu/g)	Absent

Total Plate Count:

To determine the plate count, the following procedure was employed: From each dilution, 0.1 ml was added in duplicate to the plates containing plate count agar, and then spread using a sterile spreader (spread plate method). Subsequently, the plates were incubated at 37°C for 48 hours, and the colonies were counted. The colony counts were then calculated and expressed as log CFU per gram of the sample. Alternatively, 1 ml of each dilution was added in duplicate to sterile Petri plates containing sterile plate count agar, which was cooled to 45°C. The mixture was thoroughly mixed, and the media allowed to solidify before incubation and subsequent colony counting (pour plate method) (Guo, 2016).

Detection of Enterobacteriaceae:

To determine the presence of Enterobacteriaceae, the following procedure was implemented: Buffered peptone water was utilized to incubate the test portion at 37°C for a period of 18 hours, with an additional 2 hours. Following this, the enrichment broth (EE broth) was inoculated with culture obtained from the pre-enrichment stage. Violet red bile glucose agar, serving as a selective media, was then inoculated with culture from the enrichment. The plates were subsequently incubated at 37°C for 24 hours, with an additional 2 hours. The characteristic colonies observed were confirmed by assessing fermentation of glucose and the presence of oxidase (Dayaland & Modi, 2017).

Total coliform:

To ascertain the coliform count, the following procedure was employed: The number of coliform bacteria was determined using the most probable number technique (MPN method) (Gao et al., 2019). From the initial three dilutions, 1 ml each was added into five tubes (for each dilution) of Brilliant green lactose bile broth. These tubes were then incubated at 37°C for a duration of 48

hours. Turbidity and gas formation (collected in Durham's tubes within the media) were observed. The count of positive tubes was recorded, and the counts in the original sample were enumerated by consulting the MPN table (Koc et al., 2011).

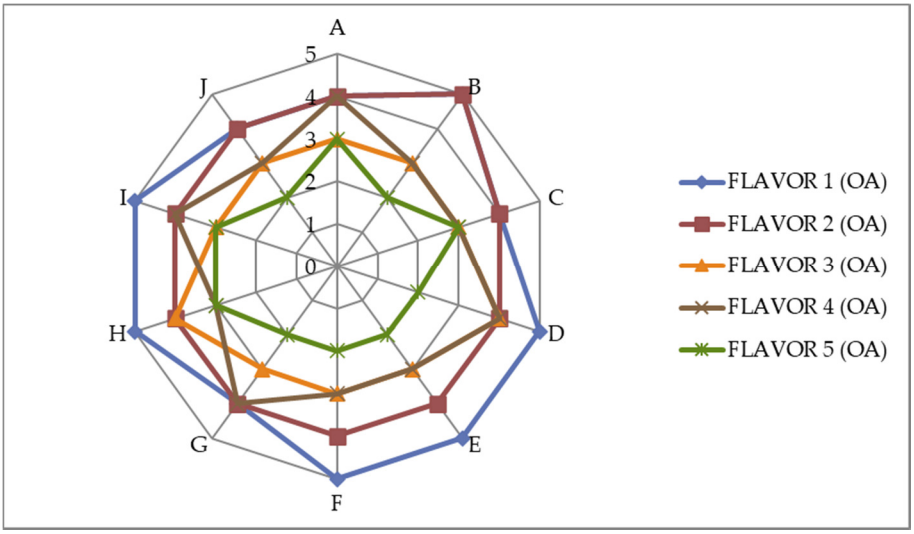

Fig:3 Sensory Evaluation of flavoured egg spread

Sensory Analysis (Mean Values) Of All Flavoured Spread:

Sensory analysis was carried out with the participation of 10 trained panellists from the industry. The mean values obtained from the sensory analysis indicated that Flavors 1 and 2 were rated favourably compared to other Flavors. Specifically, in the case of the Strawberry flavour, the flavour was indiscernible initially, but an increase in flavour intensity resulted in unsatisfactory taste perception. Regarding the Mango flavour, while the desired colour was achieved, both taste and flavour were found to be lacking. Similarly, in the case of the Vanilla flavour, the flavour was rated poorly, and taste became unsatisfactory upon the addition of Egg yolk powder (Pawar et al., 2011).

Fig: 4 Chocolate flavor

Fig: 5 Pineapple flavor

Fig: 6 Strawberry flavor

Fig: 7 Mango flavor

Fig: 8 Vanilla flavor spread

CONCLUSION:

In recent years, there has been a surge in innovative products incorporating eggs as a key ingredient. One such product gaining traction is egg spread, offering a novel and nutritious option for consumers. Across all five samples, consistent levels of moisture content, ash, fat, and Total Soluble Solids (TSS) were observed. Regarding microbial analysis, the product demonstrates stability when sealed and stored at ambient temperature. Results from sensory evaluations indicate favourable reception primarily for chocolate and pineapple flavoured egg spreads. In conclusion, egg spread emerges as a promising and flavourful dietary supplement suitable for consumers of all ages, promising both health benefits and taste appeal. Based on the outcomes of the sensory analysis, Chocolate flavour (Trial 1) emerges as the most favourably received, closely followed by Pineapple flavour (Trial 2). This suggests that the integration of Chocolate and Pineapple with Egg powder results in a pleasing taste for consumers. Conversely, Strawberry and Vanilla Flavors (Trial 3 & 5) exhibit appealing appearance and texture but fail to deliver satisfactory flavour and colour intensity. In the case of Mango flavour (Trial 4), while presenting commendable appearance, texture, and colour, it falls short in replicating the authentic taste of Mango. Among these findings,

it is concluded that egg spread presents itself as a nutritious and flavourful supplement suitable for consumers of all ages.

REFERENCES

1. Anton, M. (2007). Composition and structure of hen egg yolk. In *Bioactive egg compounds* (pp. 1–6). Springer.
2. Antón, M., & Gandemer, G. (1997). Composition, solubility and emulsifying properties of granules and plasma of egg yolk. *Journal of Food Science*, *62*(3), 484–487.
3. Asghar, A., & Abbas, M. (2012a). Dried egg powder utilization, a new frontier in bakery products. *Agriculture and Biology Journal of North America*, *3*(13), 493–505.
4. Asghar, A., & Abbas, M. (2012b). Dried egg powder utilization, a new frontier in bakery products. *Agriculture and Biology Journal of North America*, *3*(13), 493–505.
5. Caboni, M. F., Boselli, E., Messia, M. C., Velazco, V., Fratianni, A., Panfili, G., & Marconi, E. (2005). Effect of processing and storage on the chemical quality markers of spray-dried whole egg. *Food Chemistry*, *92*(2), 293–303.
6. Chudy, S., Pikul, J., & Rudzińska, M. (2015). *Effects of storage on lipid oxidation in milk and egg mixed powder*.
7. Chudy, S., Pikul, J., Rudzinska, M., & Makowska, A. (2015). The effect of storage on physicochemical properties of spray-dried milk, egg and milk-egg mixture. *Acta Agrophysica*, *22*(1).
8. Dayaland, A., & Modi, V. K. (2017). Qualitative and Functional Properties of Chicken based Egg Spread. *Research Journal of Agricultural Sciences*, *8*(1), 129–133.
9. Fu, X., Huang, X., Jin, Y., Zhang, S., & Ma, M. (2020). Characterization of enzymatically modified liquid egg yolk: Structural, interfacial and emulsifying properties. *Food Hydrocolloids*, *105*, 105763.
10. Gao, Y., Li, J., Chang, C., Wang, C., Yang, Y., & Su, Y. (2019). Effect of enzymatic hydrolysis on heat stability and emulsifying properties of egg yolk. *Food Hydrocolloids*, *97*, 105224.
11. Guérin-Dubiard, C., Castellani, O., & Anton, M. (2007). Egg compounds with antioxidant and mineral binding properties. In *Bioactive egg compounds* (pp. 223–228). Springer.
12. Guo, M. (2016). *Storage stability of a commercial spray dried hen egg yolk powder*.

13. Herron, K. L., & Fernandez, M. L. (2004). Are the current dietary guidelines regarding egg consumption appropriate? *The Journal of Nutrition*, *134*(1), 187–190.
14. Juneja, L. R., & Kim, M. (2018). Egg yolk proteins. In *Hen Eggs* (pp. 57–71). CRC press.
15. Kechil, R., Mydin, A. M., Mohammad, W. A. W., & Libasin, Z. (2017). The impact of blended learning (BL) in UiTM cawangan Pulau Pinang. *International Academic Research Journal of Social Science*, *3*(1), 239–244.
16. Koc, M., Koc, B., Yilmazer, M. S., Ertekin, F. K., Susyal, G., & Bağdatlıoğlu, N. (2011). Physicochemical characterization of whole egg powder microencapsulated by spray drying. *Drying Technology*, *29*(7), 780–788.
17. Le Denmat, M., Anton, M., & Gandemer, G. (1999). Protein denaturation and emulsifying properties of plasma and granules of egg yolk as related to heat treatment. *Journal of Food Science*, *64*(2), 194–197.
18. Lechevalier, V., Nau, F., & Jeantet, R. (2013). Powdered egg. In *Handbook of food powders* (pp. 484–512). Elsevier.
19. Martinet, V., Saulnier, P., Beaumal, V., Courthaudon, J.-L., & Anton, M. (2003). Surface properties of hen egg yolk low-density lipoproteins spread at the air–water interface. *Colloids and Surfaces B: Biointerfaces*, *31*(1–4), 185–194.
20. Obara, A., Obiedziński, M., & Kołczak, T. (2006). The effect of water activity on cholesterol oxidation in spray-and freeze-dried egg powders. *Food Chemistry*, *95*(2), 173–179.
21. Orishagbemi, C. O., Ichado, I. B., & Sanda, M. E. (2017). Physical, functional and sensory properties of foam mat dehydrated whole egg powder. *J Sci Res Rep*, *15*, 1–7.
22. Pawar, D. P., Raj, K. R., & Modi, V. K. (2011). A process development, nutritional facts, sensory properties and storage stability of shelf stable egg cube. *Journal of Food Technology*, *9*(1), 18–26.
23. Rannou, C., Queveau, D., Beaumal, V., David-Briand, E., Le Borgne, C., Meynier, A., Anton, M., Prost, C., Schuck, P., & Loisel, C. (2015). Effect of spray-drying and storage conditions on the physical and functional properties of standard and n− 3 enriched egg yolk powders. *Journal of Food Engineering*, *154*, 58–68.
24. Ruxton, C. H. S., Derbyshire, E., & Gibson, S. (2010). The nutritional properties and health benefits of eggs. *Nutrition & Food Science*, *40*(3), 263–279.

25. Sanusi, A. Z., Jibia, Z. S., Garba, M. G., Salisu, U. S., & Gaddafi, S. (2020). Functional Properties of Powdered and Fresh Egg Albumin and Yolk Determination. *Fudma Journal of Sciences*, *4*(3), 263–266.
26. Song, W. O., & Kerver, J. M. (2000). Nutritional contribution of eggs to American diets. *Journal of the American College of Nutrition*, *19*(sup5), 556S-562S.
27. Tang, S., Zhou, X., Gouda, M., Cai, Z., & Jin, Y. (2019). Effect of enzymatic hydrolysis on the solubility of egg yolk powder from the changes in structure and functional properties. *Lwt*, *110*, 214–222.