A FISH DESSERT CAKE: AN INNOVATIVE WAY TO UTILIZE TILAPIA FISH MEAT

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Abstract **-** This study aimed to create an innovative recipe or product for a dessert cake, using Tilapia fish meat as the main ingredient. The researchers presented the final product with supporting details gathered in the survey forms answered by expert respondents, specifically food science experts and potential industry partners. A 5-point hedonic scale was used to evaluate the sensory evaluation of the product being developed. This study sought to establish the sensory evaluation results and nutritional value of the non-traditional Tilapia fish dessert cake that would be potentially profitable and an influential contributor and booster of the Philippine tourism industry, particularly in the region of Cagayan Valley, as well as the local market. Results from the evaluation showed that the Tilapia dessert cake was appetizing, cream-colored, moist, vanilla-flavored, sweet, and had a caramel-like aroma. However, the Tilapia cake yielded high Kcalories as per the expert consultant's calculations of its nutrient content. Therefore, it is not recommended for dieting individuals; instead, it would be more of a treat that could be consumed on cheat days or special occasions. Recommendations include advancement to phase two of development, further laboratory testing, application for FDA approval and WIPO licensure.

Keywords **-** Tilapia, dessert cake, innovative recipe, sensory evaluation, Cagayan Valley.

INTRODUCTION

The continuous evolution of culinary trends, especially in the desserts category, has undoubtedly come a long way, and as an integral part of a menu, cakes, most significantly, have often been a hit for everyone regardless of the occasion being synonymous with happiness and celebration as much as they had become a symbol for any success or milestone. However, considerations of more health benefits, affordable costs, and an abundance of resourced food items have led to unique innovations in using non-traditional ingredients – including seafood, in some of the evolving gastronomic recipes of today. Tilapia was one of the most consumed food items since it contained vitamins D, B12, and omega-3 fatty acids that could help prevent cancer. This famously aqua-cultured fish was characterized by its mild taste, flaky and firm flesh, and loaded with nutrition as well (Bonvissuto, 2021). However, despite its significant consumer acceptance and adaptability to other flavors, the Tilapia fish meat had been confined to the more traditional dishes.

Since fish was an essential dietary component, especially for coastal communities, fishcakes branched into various regional varieties. Traditionally, cod was used as a filler, but other white fish-like haddock, whiting, or Tilapia, were used when it declined. Other countries, such as Nigeria, even developed Tilapia meat spread and used Tilapia and catfish for fish crackers.

Food establishments in Manila, such as cafés, bakeshops, tea houses, and restaurants, commonly offer more traditional dessert menus. Sweet confections such as ice creams, tarts, and cakes were made using fruits and chocolates that were more familiar to customers. In comparison, seafood such as Tilapia was used more to create appetizers, main course dishes, and snacks such as fishcakes, fish balls, fish sticks, or other salty treats. But no matter how versatile the Tilapia fish meat may be, it had never crossed the boundaries from being a savory-salty dish to the category of a sweet dessert in this location.

The Tilapia fish continued to be underutilized due to limitations of available and accepted products where it was currently being used. Among the studies on foreign and local products and recipes using Tilapia fish meat, it was typically savory dishes, condiments, and salty snacks.

Currently, very few have ventured into extending its versatility as the main ingredient for sweet desserts, such as the Tilapia Ice Cream (Zuraek, 2016), the fried coconut-flavored Tilapia mossambica purple and sweet potato cake (Quiping et al., 2014), and the Tilapia mossambica green tea crisp biscuit (Yingchun, 2015).

A search through the WIPO website by the researchers has also yielded a "No Results" turnout for the Tilapia fish dessert cake even after the entire set of ingredients (including the scientific names per item) had been used. The multiflavored dessert cake (McCarrick, 2003) had been the closest prior art from the website. However, none of its patented multiple flavor claims contained Tilapia fish meat.

Introducing Tilapia fish dessert cake to the current market would undoubtedly push the known limits of the effective use of Tilapia fish meat. This study was meant to showcase a novel product

development that utilized this underrated food item. It opened the door for a broader exploration of its versatility as a main ingredient at the dessert level. Moreover, this product innovation could yield a promising commodity when released in the market – supporting the current local food businesses and the local Tilapia fish farm sector.

The study focused on developing a dessert cake using tilapia (Oreochromis mossambicus) fish, determined its nutritive value, and conducted sensory evaluation considering the following criteria: appearance, color, texture, flavor, taste, and aroma. The researchers also anchored the study with the following assumptions as the default preference of Filipinos in consuming cake and cake-related products such as Moist cakes are better preferred by the consumers (Curuchet et al. 2021) over dry-textured cakes and Cakes with vanilla or caramel-like flavors stand as the primary choice of cake enthusiasts' consumers for the standard cake (Garvey et al. 2021).

METHODS

This is experimental research developing and transforming tilapia fish meat into a dessert cake. The researchers utilized an adapted and modified research instrument (Evangeline and Himayuri, 2020), scrutinized by a panel of experts (nutritionist and dietitian, pâtissier, and culinary experts) to elicit data from the respondents (cake enthusiasts and bakers) together with taste-test analysis. The research instrument also ran a validation test using Cronbach's alpha (a= .811).

There were 15 participants in this study. As mentioned by Cohen et al. (2007, p. 102), it stated that determining the sample size was related to the research style, and experimental methodologies required a sample size of 15 participants at a minimum. In this regard, the researchers set the target number of respondents to be fifteen (15) individuals, consisting of all food science experts. They included the survey duration, which took place for seven (7) days, in gathering data for this study. The Purposive Sampling design was used by the researchers in selecting and screening respondents based on criteria such as fond interest in cakes and pastries, pâtissier, baker, licensed nutritionist, and dietician, and work closely related to food science.

The study also utilized descriptive statistics to analyze further numerical data, including the weighted mean, percentage, and frequency distribution.

LITERATURE REVIEW

The Tilapia was a highly versatile fish that successfully conquered global aquaculture because it was easy to breed. Its good resistance to diseases, affordability, and accessibility to all fish farmers quickly made it one of the most produced and consumed fish species worldwide. The abundance of this water resource, its high nutritional content, and adaptability to other flavors made it a great candidate for developing various recipes. Despite that, the limitations of these available recipes and conducted studies from both foreign and local sources, particularly in the sweet dessert lineup, also restricted the full extent of its utilization and potential profitability.

First and foremost, the researchers searched the WIPO official website for any patented recipe and product under Tilapia fish in the dessert cake category. Still, there currently needed to be patented products that showed. Likewise, the researchers used the complete recipe ingredients, scientific names included, to search, and the results still needed to show patented recipes for the Tilapia dessert cake on record. Regarding the Tilapia fish being used as an ingredient, the WIPO search yielded the Tilapia Mossambica and Green Tea Crisp Biscuit patent. Yingchun (2015) of China claimed the use of Tilapia, cucumber, egg, flour, green tea powder, powdered sugar, and ginger, prepared and oven-baked to crisp biscuits were nutritious, great tasting and meet people's demands for biscuits. Qiuping, Meihua, Yao, and Chenfang (2014) showcased the prepared food using Tilapia mossambica, coconut cream powder, and sweet potato powder for the patent recipe of a microwavable or an oil-fried cake.

Regarding the dessert cake lineup, the closest prior art from WIPO to this research was the patented Multi-flavored Dessert Cake recipe. McCarrick (2003) claimed that in the recipe, various combinations of flavored syrups were absorbed by each portion of sponge cake combined into a single multi-flavored dessert cake. Still, there was no Tilapia fish present in any of the claims.

In addition to this, Begum et al. (2017) conducted a study in Bangladesh in terms of the development of a highly nutritious fish cake from mixed fish species, namely Tilapia (Oreochromis mossambicus), Silver Carp (Hypophthalmichthys molitrix), Pangas (Pangasius pangasius), Hilsa (Tenualosa Elisha), and Mola (Amblypharyngodon mola). The processed mixed fish meat paste, wheat flour, boiled potato, herbs, spices, lemon juice, and seasonings were baked in small containers until hard and browned.

Furthermore, Dela Victoria's study (2016) showed the development and acceptability of certain processed products using Tilapia (Oreochromis niloticus) as the main ingredient. The product selections

were limited to Tilapia Lumpia, Tilapia Siomai, Tilapia Kropeck, and Tilapia Fishball. Although the study also found that the accepted recipes were nutritious and essential to one's growth and development, the utilization of Tilapia meat still revolved around the more traditional recipes and preparation.

However, Zuraek (2016), C.L.S.U.'s Tilapia Ice Cream Bags International Award, disclosed in the article a breakthrough recipe developed by the research team of C.L.S.U. with the creation of an ice cream using Tilapia fish meat as its main ingredient. The recipe had been included in the SIAL ASEAN Manila 2016 food expo and garnered the International Gold Award that year. In line with this development, Vera Cruz, D. (2018) claimed a WIPO patent about eliminating the fishy aftertaste of Tilapia fish meat to make it suitable for creating dessert products. As a result, this event substantiated the further exploration of Tilapia fish meat's potential in the sweet dessert menu.

RESULTS AND DISCUSSION

As stated in the study's assumptions, most Filipinos preferred moist cakes according to the articles depicting assessments from the delivery food couriers and various food establishments (Madarang, 2021). The flavor of vanilla and caramellike variants was their primary choice (Añonuevo, 2019), based on online articles about cakes, best cakes, shops, etc., for the past years. This was where the team found and guided their product development on how to prepare best and create the fish-starred dessert, and it was used as the basis of the five (5) baking trials that were conducted.

Figure 1. The developed TiFiNess Cake product on its 5th trial.

Table 1. The TiFiNess Cake product development by trials.

Recipe: The TiFiNess Cake

Yield: Baking Temp.: Cooking Time:	1 whole - 6" round cake									
	300ºF		200ºF		200ºF		260ºF		300ºF	
	40mins - 1hr		30 – 45mins		30 - 45mins		17mins		45mins	
Ingredients:	***Trial 1***		***Trial 2***		***Trial 3***		***Trial 4***		***Trial 5***	
	Qty	***Unit***	***Qty***	***Unit***	***Qty***	***Unit***	***Qty***	***Unit***	***Qty***	***Unit***
Tilapia (cultured, steamed, flaked)	500	g	500	g	500	g	-	-	500	g
Tilapia (dried/ground)	-	-	-	-	-	-	34.48	g	-	-
Condensed Milk	300	ml	300	ml	300	ml	-	-	300	ml
Evaporated Milk	-	-	-	-	-	-	-	-	140	ml
Fresh Milk	-	-	-	-	-	-	187.5	ml	250	ml
All-purpose Cream	250	ml	250	ml	250	ml	-	-	-	-
Calamansi	62.5	ml	-	-	-	-	-	-	-	-
Lemon	-	-	90	ml	90	ml	-	-	90	ml
Vinegar	-	-	-	-	-	-	7.39	ml	14.78	ml
Sugar (white)	220	g	220	g	220	g	110	g	-	-
Castor Sugar	-	-	-	-	-	-	-	-	225	g

Salt	1	g	3	g	3	g	1.5	g	3	g
Eggs (yolk)	36	g	72	g	72	g	-	-	-	-
Eggs (whole, beaten)	-	-	-	-	-	-	100	g	200	g
All-purpose Flour	256	g	-	-	-	-	192	g	384	g
Self-raising Flour	-	-	450	g	450	g	-	-	-	-
Baking Soda	7	g	7	g	7	g	3.5	g	7	g
Yeast	-	-	3	g	-	-	-	-	-	-
Baking Powder	-	-	-	-	-	-	5	g	10	g
Cooking Oil (canola)	187.5	ml	187.5	ml	187.5	ml	187.5	ml	187.5	ml
Vanilla Extract	-	-	-	-	-	-	2.46	ml	-	-

Buttercream Icing:							***Qty***	***Unit***	***Qty***	***Unit***
Shortening	-	-	-	-	-	-	102.5	g	102.5	g
Unsalted Butter (2 sticks)	-	-	-	-	-	-	225	g	225	g
Icing Sugar	-	-	-	-	-	-	500	g	500	g
Fresh Milk	-	-	-	-	-	-	60	ml	60	ml
Vanilla Extract (opt.)	-	-	-	-	-	-	44.37	ml	44.37	ml

The study focused on the first phase of developing the Tilapia dessert cake product. In this light, the team conducted several trials to obtain the most compatible combination of ingredients to create the recipe, which was aptly named the TiFiNess (Tilapia Fish in FairNess!). Cake. Table 3 summarizes the five (5) baking trials done by the researchers in developing the best possible outcome for the Tilapia dessert cake under the guidance of the baker consultant. It reflected all the ingredients used throughout the entire period of the conducted trials, including the ingredients list for the buttercream icing as well.

Table 2. The TiFiNess Cake product development by trials.

Trial #	*Output Description*
Trial 1	• Cake bread is moist. • Cake has a strong fishy taste, and not enough calamari is used. • Took too long to bake (40mins - 1hr).
Trial 2	• Cake bread is dry. • Not enough sweetness. • No fishy taste.
Trial 3	• Cake bread is slightly crumbly. • The sweetness is just right. • No fishy taste.
Trial 4	• There is a hint of fishy taste, but when combined with the buttercream icing, the fishy taste is lessened. • The use of dried and ground Tilapia meat produced quite a dense cake bread, while the icing is soft. • Cake bread texture is soft and chewy, while the icing is smooth and grainy. • The cake aroma is slightly “fishy,” while the icing smells sweet.

Trial 5	• Sweetness is just right. • Cake bread is soft to chew but a little heavy. • Freshly baked batch has no fishy taste/aftertaste. • Freshness held up until about 24 hours of storage in the refrigerator, then slightly decreased but blended well with the buttercream icing. • Samples stored beyond 3-4 days had gradual hints of the fishy taste and smell.

Table 2 outlines the various end-product results for every baking trial conducted. It also showed how the different ingredient combinations affected the product output per trial. It also revealed that the results of the 5th trial produced the best product output with potentially acceptable quality.

Table 3. The standardized recipe used in the 5th trial of the Tilapia dessert cake.

Recipe Name:	Tilapia Dessert Cake	Yield:	1 (6-in cake)
Category:	Dessert		6 slices
Cooking Method:	Baking	Baking Temp:	300°F
(5th trial)		Cooking Time:	45 mins

Ingredients	***Qty***	***Unit Cost***	***Total***
Tilapia (cultured, steamed, flaked)	500 g	0.40	200.00
Condensed milk	300 ml	0.18	54.00
Evaporated milk	140 ml	0.18	25.20
Lemon	90 ml	0.44	39.60
Castor sugar	225 g	0.16	36.00
Salt	3 g	0.09	0.27
Eggs (med., whole, beaten)	200 g	0.16	32.00
All-purpose flour	384 g	0.14	53.76
Baking soda	7 g	0.20	1.40
Baking powder	10 g	0.40	4.00
Fresh milk	250 ml	0.15	37.50
White vinegar	14.78 ml	0.12	1.77
Canola Oil	187.5 ml	0.01	1.88
Total		*1 whole =*	*451.38*
		1 slice =	*75.23*

Table 3 displayed the standardized recipe of the 5th trial, which rendered the most acceptable output among all the experimented recipes. This recipe would then be followed to create the samples used in the planned taste-testing experiment for the sensory evaluation.

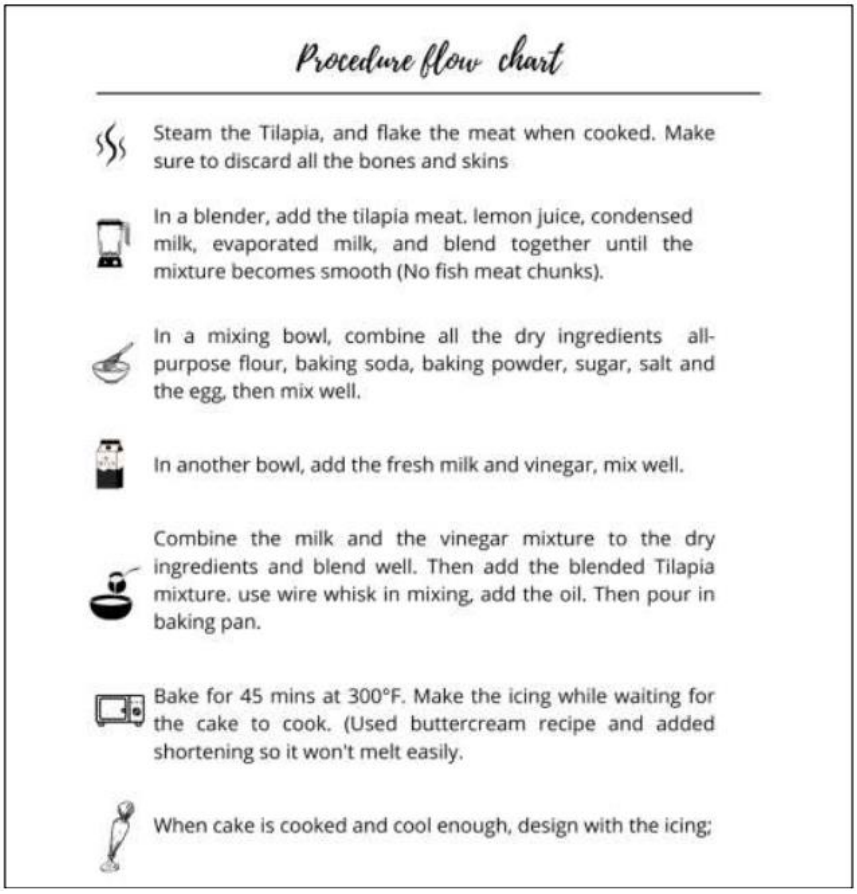

Figure 2. The developed TiFiNess Cake procedure flow chart.

Table 4. Computed nutritional values of the Tilapia dessert cake per slice.

Whole cake = 558 g *Grams / Slice = 93 g* *Total Slices* = 6	***Nutrition Facts***	
	Serving Size	***1 Slice (93 g)***
	Amount per serving	***% Daily Value***
	Kcalories 742.6	37%
	Total protein (g) 32.14	45%
	Total fat (g) 15.31	19%
	Sodium (mg) 490.78	20%
	Saturated fat (g) 6.29	27%
	Cholesterol (mg) 166.67	55%
Remarks:	• No fishy taste and smell. • No problem with the flavor. • Buttercream icing complemented the cake bread taste. • Heavy but airy.	

Table 4 displayed the nutritive values of the Tilapia dessert cake as per the calculations made by the team's consulted expert in nutrition/dietetics and food science. It also showed the assessment conducted on the sample delivered to him. The calculated nutrient contents revealed a high Kcalorie percentage value and cholesterol as well. This reflects that the product is not recommended for dieting individuals and is meant to be consumed occasionally.

Figure 3. Baked Tilapia dessert cake 5th trial samples.

Cupcake-sized samples of the Tilapia dessert cake were baked and sent to the fifteen (15) expert respondents who participated in the survey and taste-testing experiment. Survey questionnaires using the 5-point Hedonic scale format were sent via Google Forms for the data gathering.

Table 5. Appearance evaluation results

Appearance	f	%	Rank
Fluffy/Soft	6	40%	2
Appetizing	9	60%	1
Total	15	100%	

Results of Table 5 showed that most participants (60%) found the product visually appealing and enough to stimulate the appetite by first encouraging the eyes. Cakes were not simply baked anymore; they had to be made visually appealing and bring a new life (Kurian, 2019).

Table 6. Color evaluation

Color	f	%	Rank
Pale	1	6.7%	3
Cream-colored	10	66.7%	1
Light Brown	4	26.7%	2
Total	15	100%	

For Table 6, most respondents chose Cream-colored, a more favorable color for pastries, at 66.7%. In terms of cakes, they are of poor quality when the color becomes too dull, pale, uneven, or dark.

Table 7. Texture evaluation.

Texture	f	%	Rank
Soft	1	6.7%	2.5
Moist	13	86.7%	1
Chewy/Sticky	1	6.7%	2.5
Total	15	100%	

Table 7 yields a high majority for Moist (86.7%) as the sample's texture. Food texture, in terms of mouthfeel, refers to the test and assessment of food from the initial palate perception – first bite – chewing – swallowing – to aftertaste (Borro and Gemora, 2016). Moist cakes were more enjoyable to consume and bring out the richness of the cake bread itself when eaten. While dry and crumbly cakes were less pleasing and could not be easily fixed even with good icing.

Table 8. Flavor evaluation.

Flavor	f	%	Rank
Citrusy	2	13.3%	3.5
Vanilla	6	40.0%	1
Caramel-like	2	13.3%	3.5
Buttery	5	33.3%	2

Total	15	100%	

Table 8 showed that most respondents (40%) found the sample cake to have a Vanilla flavor, which was also a more favorable cake flavor. A good quality cake would contain an essence of authenticity in its flavor and one that did not clash but would be complemented by its icing.

Table 9. Taste evaluation.

Taste	f	%	Rank
Slightly Sweet	5	33.3%	1.5
Sweet	5	33.3%	1.5
Savory	4	26.7%	3
Fishy	1	6.7%	4
Total	15	100%	

As per the taste in Table 9, results yielded a split choice between Sweet and Slightly Sweet descriptions according to the respondents at 33.3% each. Results suggested that the sweetness level of the sample was not too high or overpowered in taste.

Table 10. Aroma evaluation.

Aroma	f	%	Rank
Citrusy	5	33.3%	2
Nutty	1	6.7%	3.5
Caramel-like	8	53.3%	1
Chocolatey	1	6.7%	3.5
Total	15	100%	

For the aroma in Table 10, most respondents chose Caramel-like 53.3% to describe the scent of the sample cakes. This showed another product feature that was favorable for future cake consumers. According to Keefie (2019), aroma plays an integral role in people's perception of food. Much like the visual appeal, the aroma was an essential characteristic of a cake that made it all the more appetizing to anyone. Pleasant, sweet, and natural were usually the signs of a quality cake, while flat, musty, and sharp were of poor standards.

Table 11. Remarks, comments, and suggestions of the expert respondents after testing.

Line by line	Selective Coding	Themes
R1: The cake is moist, with no hint of fishy or fishy smell.	No fishy smell. The cake is moist.	Acceptable product quality.
R3: Unique taste; you won't notice a fish in it.	Unnoticeable fish in taste.	
R8: Not so sweet, it's buttery and very resourceful in using tilapia as an ingredient. Job well done, researchers!	Job well done. Buttery. Not sweet	
R11: I need help to think of any improvement as of this writing. Good job! Not too sweet, just right :)	Good job. Not sweet.	
R14: Delicious and yummy.	Delicious cake.	
R6: The taste is good. Add more lemon next time to make it better. Thank you	Good taste. Needs more lemon.	
R5:4 days before consumed.	Good shelf-life.	
R9: So sweet. Reduce sugar.	Decrease sugar amount.	The product needs improvement.
R10: Maybe less sugar next time.	Lessen sugar.	

R13: If you want the cake base light, use cake flour instead of all-purpose flour. I also noticed some discoloration in the sliced cake. Try to lessen the amount of liquid ingredients or add dry ingredient	Use cake flour—less liquid ingredient amount. Add dry ingredient amount.	
Continuation Table 14:		
R4: It is better to put some cream cheese for the frosting.	New option for icing.	
R15: Improve the packaging	New packaging option.	
R2: More fish and check fish bones	Fishy taste	

Two (2) themes emerged from the respondents' remarks, comments, and suggestions, as per Table 11, and they were Acceptable Product Quality and Product Needs Improvement. Remarks of the expert respondents who participated in the experiment revealed that the majority had commented on excellent and promising feedback regarding the quality of the developed product. Regarding the improvements, ingredient adjustments in line with our respondents' suggestions and feedback would significantly affect the upgrades the Tilapia dessert cake would undergo.

CONCLUSION

Published articles online and café / cakeshop findings supported the assumptions of this study that most Filipinos preferred moist cakes and that vanilla was the people's first choice when it came to cake flavors. This served as the researchers' basis for the development of a recipe that yielded a promising version of the Tilapia dessert cake with acceptable quality and adequate shelf-life. Of all the trials conducted, the 5th produced the best product output possible.

The nutritional values showed that the Tilapia dessert cake had a high-calorie percentage. It was also calculated as high in cholesterol; therefore, this cake would not be recommended for individuals with high sugar levels and those who would be dieting. This cake was created as a dessert and served as a sweet treat for different occasions for people to enjoy, but it is only advisable to consume it in small amounts or daily, except maybe on cheat days.

The survey and taste-testing experiment done by the 15 expert respondents for the sensory evaluation of the product became the basis for improving the product by assessing its flavor, texture, aroma, consistency, and color. The gathered results, remarks, comments, and concerns were used to address the problem, precisely its fishy taste. However, particular aspects still needed to be improved, and the researchers noted those suggested improvements for further product development.

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