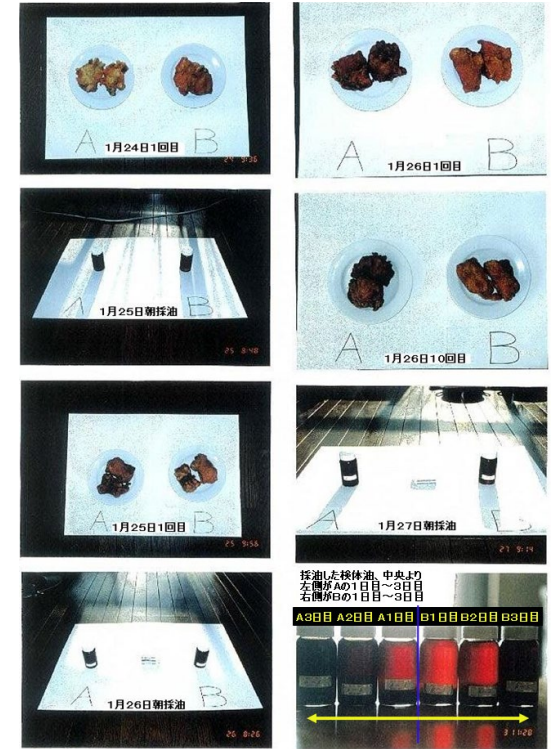


Analysis results of fried oil degradation comparison experiment by fried chicken
A = Cooking oil without additives B = Cooking oil blended with GREX

	Acid value	carbonyl value	Smoke point (° C)	Color (transparent color)
	A B	A B	A B New oil at 239 242	I A B
Day 1	1,16 0,73	8,3 7,8	195 200	46,1 56,8
2nd day	1,41 0,77	9,0 7,7	192 198	30,0 50,4
3rd day	1,80 1,14	9,6 8,3	186 190	20,0 35,3
standard	Not available above 2,5	Not available above 50	Cannot be used below 170° C	The higher the value, the brighter the oil. b is brighter than a, indicating that the use of GREX makes fried oil less likely to be contaminated.
evaluation	The fact that day 1 of A and day 3 of B are almost the same shows the antioxidant effect of B at high temperatures.	The fact that day 1 of A and day 3 of B are the same shows the antioxidant effect of B at high temperatures.	B is about 5° C higher, indicating that the use of GREX improves the heat generation efficiency.	



Analysis: Japan Food Analysis Center

Basic Experiment of GREX: Research Center for Advanced Science and Technology, The University of Tokyo

The following experiments were conducted to gain basic insight into the antioxidant effect of the vegetable complex extract GREX on oil oxidation.

【Reaction of galvinoxyl radicals with GREX】

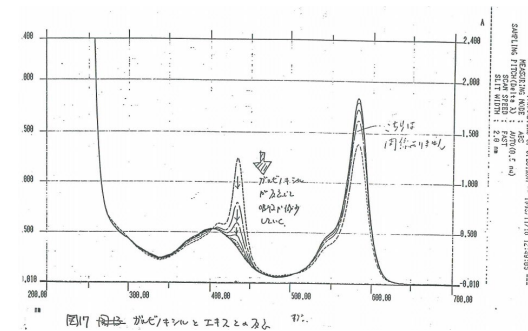
Antioxidants with high antioxidant activity, such as vitamin E, which rapidly scavenges radicals, are known to react with galvinoxyl radicals as well. By looking at the reaction with galvinoxyl radicals, the activity of GREX can be evaluated. Here we measured the reaction of GREX with galvinoxyl radicals.

【Result】

GREX reacts with galvinoxyl radicals, indicating that GREX acts as a radical scavenger.

【Conclusion】

Based on the results of the galvinoxyl radical experiment and the clinical experiments conducted by Hokuei Kenkyujo, it can be said that GREX has antioxidant properties even above 150 degrees Celsius, where the activity of vitamin E decreases, while retaining its active power.



Study on Protective Effect of GREX on Oxidation Stability of Oil under High-Temperature Frying

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GREX, when added to cooking oil (hereafter referred to as "oil") before cooking, protects the oil and reduces the emission of harmful ingredients released into the oil from the object to be fried. This saves oil and costs and ensures that the fried food always retains its delicious fried flavor. In this experiment, we actually used oil with and without GREX added to fry chicken and croquettes while measuring changes in the concentration of TPM (Total Polar Materials: a global standard edible oil degradation index; less than 25% of the waste oil standard value) in the oil using Testo 270, and also performed weight comparison measurements for the croquettes to examine the effect of adding GREX. The effect of GREX addition was examined.

Materials and tools: GREX frying oil additives, canola oil (rapeseed oil), chicken nuggets, fried chicken wings, beef croquettes, temperature-controlled electric fryer, Testo 270

Experimental Methods: 5 L each of canola oil with and without GREX was placed in an electric fryer; for GREX-added oil, 6 mL of GREX (0.12%) was added to 5 L of oil. The temperature was set to 170° C in both electric fryers. Food samples (chicken nuggets, fried chicken wings, and croquettes) were then placed in a metal basket attached to the fryer and immersed in the heated oil to cook. In order to maintain a constant oil temperature of 170° C, the time between pulling up the fried food and placing the next sample in the oil differed slightly depending on the sample. However, the time to fry each sample was constant. Five chicken nuggets in a basket were dipped into 170° C oil and fried for 6 minutes. This process was repeated six times for a total of 30 chicken nuggets. Continuing with the same oil, three fried chicken wings were placed in each basket and fried in oil for 12 minutes. This operation was repeated 5 times for a total of 15 deep-fried chicken wings. Changes in the concentration of TPM during this period are shown in the table below. In the croquette experiment, two croquettes were placed in a basket each time and fried for 5 minutes. This operation was repeated 15 times for a total of 30 croquettes. During this time, TPM was measured before frying, 2.5 minutes later, and 5 minutes after the end of frying.

Table 1 [Results of fried chicken nuggets and fried chicken wings experiment].

	Chicken nuggets, 5 each time, 6 min.								Fried chicken wings, 3 each time, 12 min.				
	N	0	5	10	15	20	25	30	3	6	9	12	15
total number of pages	O												
Hours.	M	0	6	12	18	24	30	36	48	60	72	84	96
GREX-added TPM	%	5.5	8.5	8.5	9.0	9.0	9.0	9.0	9.5	10.0	10.0	10.0	10.0
GREX additive-free TPM	%	6	12	15.0	17.0	17.5	17.5	17.5	31.0	28.0	24.0	20.0	11.5

As shown in Table 1 and Figure 6, the TPM of oil in chicken nuggets and fried chicken wings is, that without the addition of GREX, it increases significantly as frying. It can be seen. On the other hand, the addition of GREX, even with only 0.12% of TPM. The concentration is only increased by a few percent. Also, in the case of chicken nuggets, adding GREX. Otherwise, it increases with time and shows a constant amount at about 10% of the same charge. On the other hand, In fried chicken wings, there is a significant increase once, followed by a gradual decrease.

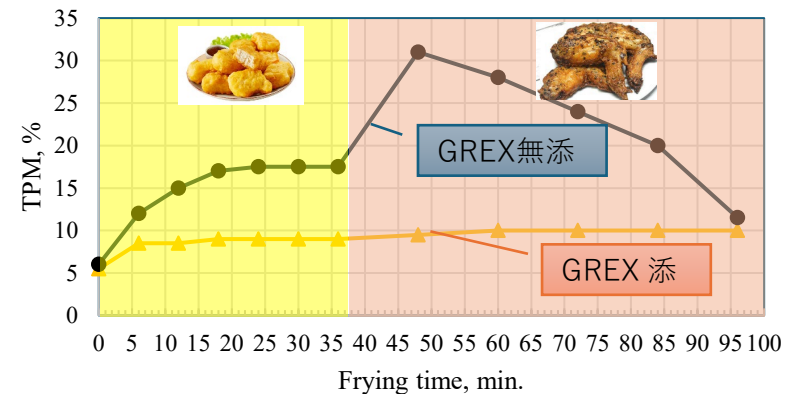


Figure 6: Total Polar Substance Content in Oil in Deep Fried Chicken

This indicates that TPM is not merely an increase in polar substances due to oil oxidation, but is significantly increased by polar substances released into the oil from the fried object. This suggests that the effect of GREX is not only to increase the oxidation stability of the oil, but also to prevent the release of polar substances released from the object to be fried. This needs to be clarified by liquid chromatography analysis of TPM substances.

【Experiments with croquettes】

Table 2
Change in TPM when croquettes are fried
(before frying (0 min), during frying (2.5 min), after frying (5 min))

Number of croquettes	Hours, minutes	GREX-free			GREX Addition		
		0 minutes before frying	interim 2.5 min.	After frying 5 min.	Before frying 0 minutes	interim 2.5 min.	After frying 5 min.
2	5	4.0	6.5	6.5	3.5	6.5	6.0
4	10	6.0	6.5	6.0	5.0	6.0	5.5
6	15	6.0	6.5	6.5	5.5	6.5	6.5
8	20	6.5	7.0	6.5	6.0	7.0	6.0
10	25	6.5	7.0	6.5	6.0	7.0	7.0
12	30	6.0	7.0	6.5	5.5	7.0	6.5
14	35	6.0	7.0	6.5	6.0	7.0	6.0
16	40	6.0	7.0	6.5	5.5	7.0	6.0
18	45	6.0	7.0	7.0	6.0	7.0	6.5
20	50	6.0	7.0	6.5	6.5	7.0	6.5
22	55	6.5	6.5	6.5	5.0	6.5	6.0
24	60	6.0	6.0	7.0	6.0	7.5	7.0
26	65	6.0	6.0	6.5	6.5	7.0	6.5
28	70	6.5	6.5	6.5	6.5	7.5	6.5
30	75	6.0	6.0	6.5	6.5	7.5	7.0

Table 3
Weight change of croquettes before and after frying No GREX added

No	Before frying	After frying	Weight loss (W0-W1)
	W0, g	W1, g	Δ W, g
1	171.768	166.478	5.290
2	169.643	164.370	5.273
3	174.805	174.478	0.327
4	171.273	168.859	2.414
5	170.555	158.045	12.510
6	166.854	161.012	5.842
7	167.083	163.392	3.691
8	166.342	158.282	8.060
9	168.238	160.636	7.602
10	167.570	158.547	9.023
Average	169.413	163.410	6.003
Standard error	0.540	1.064	0.698

Table 4
Weight change of croquettes before and after frying GREX addition

No	Before frying	After frying	weight reduction (W0-W1)
	W0, g	W1, g	Δ W, g
1	174.810	167.522	7.288
2	171.133	161.214	9.919
3	172.384	163.842	8.542
4	174.900	166.140	8.760
5	173.914	172.523	1.391
6	164.135	158.760	5.375
7	167.871	161.515	6.356
8	173.131	163.783	9.348
9	176.283	167.672	8.611
10	172.004	159.480	12.524
11	160.455	152.236	8.219
12	165.153	164.083	1.070
13	162.039	153.943	8.096
14	166.591	159.726	6.865
15	164.751	158.653	6.098
Average	169.629	162.317	7.312
Standard error	0.687	0.709	0.399

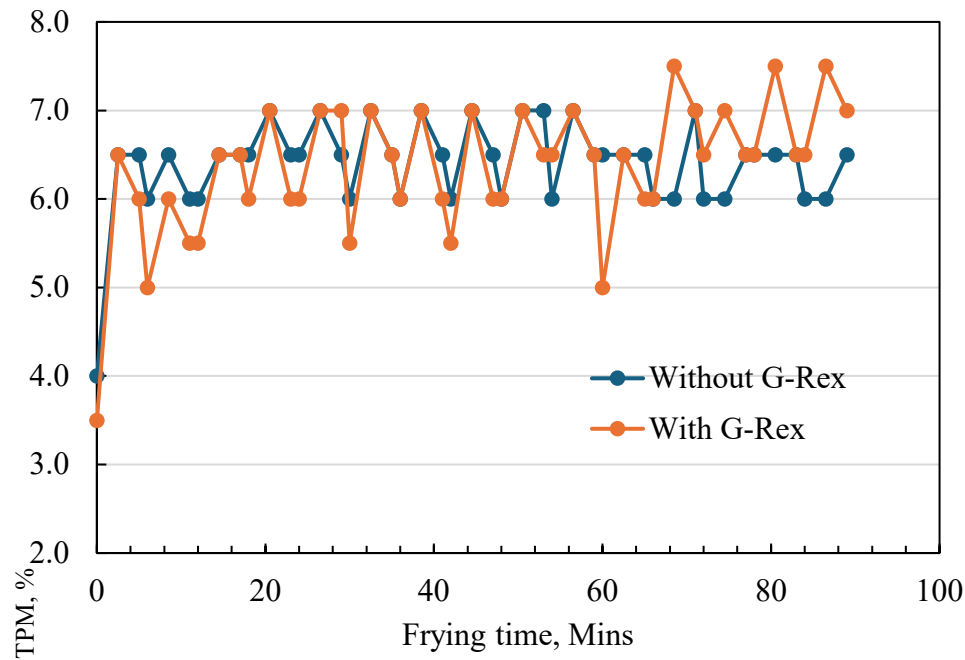


Figure 7: Total Polar Substance Content in Fried Beef Croquettes

【The difference between GREX added and no GREX added to fried beefsteak croquettes】

Table 2 and Figure 7 show the changes in TPM when beef muscle croquettes were fried. Quite different from chicken nuggets and fried chicken wings, in croquettes with batter, the TPM concentration, which was low before the croquettes were added, increased during frying, reaching its highest value at 2.5 minutes, about half of the 5-minute raising time, and when the batter was fried, the TPM concentration again decreased to almost the same value as before. This phenomenon was almost the same with or without GREX. The reason why the TPM concentration did not increase even though the oil was kept at a high temperature of 170° C for as long as 90 minutes as a whole is because (1) the croquettes, which are mainly composed of potatoes, do not contain as many TPM-producing substances as chicken, and (2) a little substance inside the croquettes does not cause the batter around them to fry well enough to stop the release of TPM-producing substances from inside. The TPM concentration in the oil is also estimated to be constant once the surrounding batter is fried well and the release of TPM-producing substances from the inside stops. Therefore, the weight of croquettes was measured before and after frying, and the difference was calculated; the weight change without GREX is shown in Table 3 and that with GREX is shown in Table 4. Table 4 shows the weight change of croquettes before and after frying when GREX is added.

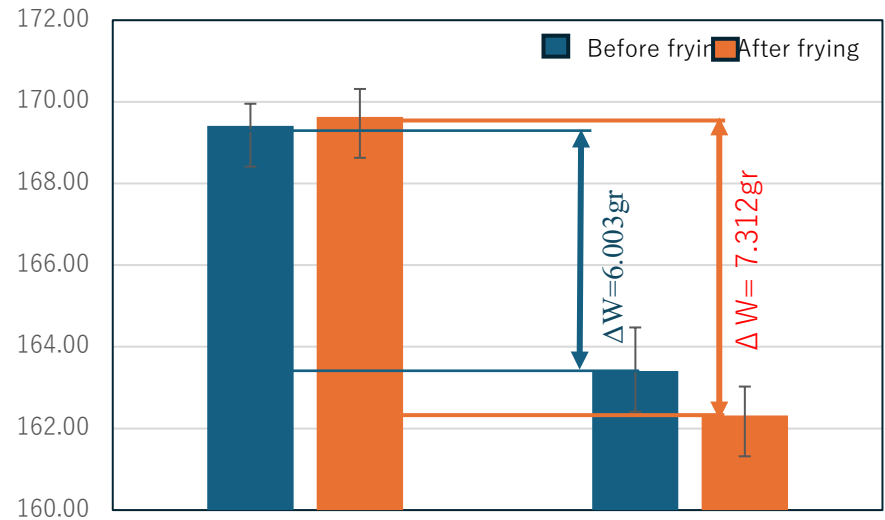


Figure 8: Change in croquette weight

【Weight comparison of fried beef croquettes oil absorption】

The weight of croquettes was measured before and after frying, and the difference was calculated to compare the oil absorption. The average of these weight changes is shown in Figure 8, as it is difficult to tell from the numbers alone. With and without GREX, the weight decreases significantly after frying. This is because the moisture contained in the potato, the main ingredient of the croquettes, evaporates in large quantities during frying and is lost from the croquettes; the amount of moisture evaporated is constant whether GREX is added or not because the oil temperature is constant at 170° C and the frying time is constant at 5 minutes. However, the greater weight loss with GREX is thought to be due to less oil absorption into the croquettes during the frying process. In other words, the use of GREX reduces the amount of oil absorbed by the fried food. Naturally, the calorie content is also reduced.