KOREAN J. FOOD SCI. TECHNOL.
Vol. 14, *No.* 1 (1982)

Processing Conditions and Quality Stability during Storage of Meaty Textured Fish Protein Concentrate

Ⅱ Quality Stability during Storage and Utilization of Meaty Textured Fish Protein Concentrate from Filefish and Sandfish

Eung-Ho Lee, Duck-Jae Cho*, Joong-Kyun Jeon, Yong-Jun Cha and Se-Kwon Kim
Department of Food Science and Technology, National Fisheries University of Busan, Busan 608
**Department of Food Industry, Kyung Nam Junior College of Technology*
(Received November 27, 1981)

축육과 유사한 텍스쳐를 가진 어육단백질 농축물의 가공조건 및 저장중의 품질변화

제 2 보 : 저장중의 품질변화

이 응호 · 조 덕제* · 전 중균 · 차 용준 · 김 세권
부산수산대학 식품공학과, *경남공업전문대학 식품공업과
(1981년 11월 27일 수리)

Abstract

Quality of meaty textured fish protein concentrate (MT-FPC) prepared from filefish, *Navodon modestus*, and sandfish, *Arctoscopus japonicus*, was investigated. The stability of the product during storage under various conditions was evaluated with rehydration capacity, thiobarbituric acid (TBA) value and browning colour density.

MT-FPC packed in glass bottle with air and stored at room temperature showed no significant differences in TBA value, rehydration capacity and browning colour density during the storage period of 90 days. The jelly strength of product prepared from filefish was weaker than that of sandfish: and beef meat could be substituted with MT-FPC up to 50% in making hamburger and fried meat balls without a significant loss in taste, odor and texture.

Introduction

Few researchers have studied on quality of meaty textured fish protein concentrate (MT-FPC) stored under various storage conditions[1~3]. In the previous paper[4], we reported that the processing conditions of MT-FPC from filefish and sandfish. In this paper, an investigation on quality stability of MT-FPC during storage, and utilization as a food material was conducted.

Materials and Methods

Preservation experiment of MT-FPC

The products, which were produced on optimum

processing conditions as reported in previous paper[4], were inserted into 500 *ml* glass bottle, and changes of the rehydration capacity, thiobarbituric acid (TBA) value and browning colour density during storage under various storage conditions were investigated.

The packing and preservation methods are as follows:

(1) Packing in glass bottle with air and stored at room temperature

(2) Packing in glass bottle with nitrogen and stored at room temperature

(3) Packing in glass bottle with air and stored at −25°C

Determination of rehydration capacity[5]

The rehydration capacity of the sample was determined as previously described[4].

Determination of TBA value[6]

An accurately weighed 1 *g* ground samples was mixed quantitatively into 500 *ml* Kjeldahl flask by adding 97.5 *ml* of distilled water and 2.5 *ml* of HCl solution (conc-HCl : H_2O=1 : 2), and then adding a drop of silicone oil and a few of capillary tubes to prevent bumping. The mixture was distilled, and then 50 *ml* of solution were accurately collected. To 5 *ml* of the distillate 5 *ml* of TBA reagent were added, and then mixed into 50 *ml* glass stopped tube. The mixed solution was immersed in a boiling water bath for 30 min, cooled at room temperature for 20 min, and read the optical density of the sample against the blank at a wavelength of 531 *nm*. The optical density value was used to represent TBA value.

Determination of browning color density[6]

An accurately weighed 2 *g* samples into 30 *ml* stopped flask were extracted with 30 *ml* of *n*-hexane in a dark room for 24 hrs and the extract was filterated through filter paper (Whatman No. 41). The residue was extracted with 30 *ml* of chloroform-methanol (2 : 1) solution under continuous agitation for 30 min and the extract was filterated with filter paper. After extraction and filteration, the optical density of filtrate was determined at a wavelength of 460 *nm*, which was used to calculate lipid soluble pigment.

The residue extracted of lipid soluble pigment was extracted with 50 *ml* of the distilled water for 48 hrs at 5°C, and was filterated with filter paper. After extraction and filteration, the optical density of the filtrate was determined at a wavelength of 460 *nm*, which was used to calculate water soluble pigment.

Preparation of meat balls and measurement of jelly strength

The MT-FPC of filefish and sandfish was soaked in 10 volumes of distilled water for 1 hr, the water was decanted from the vessel. In preparing meat balls, minced beef was partially substituted for MT-FPC as shown in Table 3. The mixed materials were ground in a mortar for 30 min, sealed in stainless steel molder (3.0×3.2*cm*), steamed for 30 min at 98 to 99°C and cooled. After cooling, the jelly strength was determined by using an apparatus of Okada type jelly strength tester, which records the internal mechanical stress of the meat balls under continuously increasing pressure.

Preparation of hamburger and fried meat ball

To prepare a hamburger and fried meat balls, the mince beef was partially substituted for MT-FPC as shown in Table 5 and Table 6. After ground in a mortar, the mixture was fried in edible oil, and tested for the sensory evaluation.

Sensory evaluation

The sensory evaluations of hamburger and fried meat balls were carried out by technical panels of 10 trained members, who evaluated odor, taste and texture. The sensory characteristics were graded by using an intensity scale of 1 (extremely poor) to 5 (excellent).

Results and Discussion

Changes of the rehydration capacity

Changes of the rehydration capacity of MT-FPC during storage under various storage conditions are shown in Table 1. The rehydration capacity of MT-FPC prepared from sandfish was higher than that of filefish, and that of both the product decreased with increasing of storage days. The rehydration capacity of the product packed with air and stored at room temperature or the product packed with nitrogen and stored at room temperature gradually decreased with

Table 1. Variation of rehydration capacity of meaty textured fish protein concentrate during storage under various storage conditions

Storage time (day)	Filefish			Sandfish		
	A	N	F	A	N	F
0	6.2	6.2	6.2	8.3	8.3	8.3
15	6.2	6.2	6.2	7.8	8.3	8.3
30	6.1	6.1	6.1	7.8	8.0	8.2
45	5.8	5.8	5.9	7.6	7.6	8.2
60	5.4	55.	6.0	7.3	7.7	8.2
90	5.4	5.5	6.0	7.3	7.3	7.9

A : Meaty textured FPC packed in glass bottle with air and stored at room temperature.
N : Meaty textured FPC packed in glass bottle with nitrogen and stored at room temperature.
F : Meaty textured FPC packed in glass bottle with air and stored at −25°C.

increasing of storage days, but that of the product packed with air and stored at −25°C showed no significant changes during storage.

Suzuki *et al.*[7] reported that the changes of rehydration capacity, when MT-FPC prepared from mackerel was stored at −20°C, showed less significant difference than before storage. However, that of product stored at room temperature showed notable changes.

Variation of TBA value

Variation of TBA value of MT-FPC during storage under various storage conditions is shown in Fig. 1. In the case of the porduct of sandfish, initial TBA

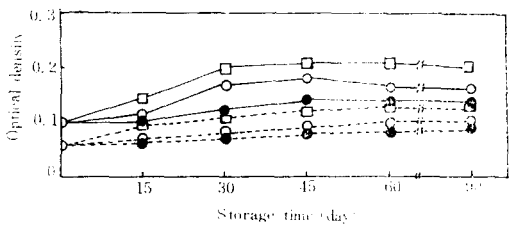

Fig. 1. Variation of TBA values of meaty textured fish protein concentrate during storage under various storage conditions

···, filefish; —, sandfish; □, A; ●, N; ▲, F; refer to Table 1

value was high due possibfly to the lipid oxidation during hot air drying. In the product of filefish, TBA value showed little significant variations during storage.

TBA value remained nearly constant after 60 days of storage regardless of packing and storage methods. TBA value of the product packed with nitrogen or stored at −25°C showed little variations during storage.

Kim *et al.*[8] recognized that TBA value, when dried Alaska pollack was stored under various relative humidities, increased until 30 days regardless of relative humidities, and gradually decreased thereafter. In case of dried sea eel, TBA value increased up 20 days, and thereafter gradually decreased.[9]

Changes of brown color density

The changes of brown color density of MT-FPC

Table 2. Variation of brown color density of meaty textured fish protein concentrate during storage under various storage conditions (Unit : O.D. at 460 *nm* ×100)

Storage days	MT-FPC (filefish)						MT-FPC (sandfish)					
	A		N		F		A		N		F	
	W	L	W	L	W	L	W	L	W	L	W	L
0	0.7	0.6	0.7	0.6	0.7	0.6	0.4	0.8	0.4	0.8	0.4	0.8
15	0.8	0.7	0.7	0.7	0.8	0.7	0.6	1.3	0.4	1.2	0.6	1.2
30	1.0	0.9	0.9	0.8	1.0	0.9	0.7	0.5	0.6	1.4	0.7	1.4
45	1.0	0.9	0.9	0.8	1.1	0.9	0.7	1.7	0.7	1.3	0.8	1.5
60	1.0	1.9	1.1	1.0	1.0	1.0	0.9	1.7	0.6	1.4	0.0	1.4
90	1.1	1.0	1.0	1.1	1.0	1.1	1.0	1.8	0.9	1.4	0.9	1.4

A,N,F : refer to Table 1, W : Water fraction, L : Lipid fraction

during stage under various storage conditions are shown in Table 2. The water and lipid soluble pigment of the products of filefish and sandfish slowly increased with increasing storage days. In the case of product of filefish, because lipid content was lower than that of sandfish, the water and lipid soluble pigments showed no significant differences during storage under various storage conditions.

In the case of the product of sandfish of which lipid content was higher than that of the filefish product, the lipid soluble pigment was more than water soluble pigment. It was agreed with the report by Fujimoto *et al.*[10], who reported that the browning of fish processing product was chiefly caused by lipid oxidation. The brown color density showed no significant differences between the product stored at −25°C and packed with nitrogen, but increased with increasing of storage days under packing with air and stored at room temperature. Therefore, it seemed that packing with nitrogen and stored at room temperature or packing with air and stored at −25°C were effective for packing and storage of the product.

Jelly strength of the product

Model meat balls were prepared with a combination of minced beef and the rehydrated MT-FPC from filefish and sandfish. The recipes were as shown in Table 3, and the determination results of jelly strength were shown in Table 4.

Under the same substitution ratio, the meat balls prepared with minced beef and MT-FPC from sandfish showed higher jelly strength than that with minced beef and filefish product. The meat balls, which were substituted with MT-FPC up to 30 to 50%, were higher jelly strength than that of meat balls prepared with minced beef, and the jelly strength in the case of 70% was almost the same as that of meat balls prepared with minced beef.

Suzuki *et al.*[11] reported that in the case of model meat balls of minced Alaska pollack, the meat was lower than beef in hardness, but the texture profile on the rehydrated MT-FPC from Alaska pollack was almost the same as that of ground beef. Since FPC usually has no good hydrophilicity and is powder, the texture of the product is no good, and utilization for a food materials is difficult. The physical

Table 3. Formular for meat ball preparation with meaty textured fish protein concentrate (Unit : *g*)

Material	Ratio of substitution				
	Control	30%	50%	70%	100%
Minced beef	76.0	53.2	38.0	22.8	0
Rehydrated MT-FPC	0	22.8	38.0	53.2	76.0
Starch	10.0	10.0	10.0	10.0	10.0
Salt	1.5	1.5	1.5	1.5	1.5
Total	87.5	87.5	87.5	87.5	87.5

Table 4. Jelly strength of meat balls supplemented with meaty textured fish protein concentrate

(Unit : *g*)

Material	Ratio of substitution				
	Control	30%	50%	70%	100%
MT-FPC prepared with filefish	387.4	410.6	398.3	373.3	240.2
MT-FPC prpeared with sandfish	387.4	435.7	410.5	389.6	267.8

Table 5. Formular for hamburger preparation with meaty textured fish protein concentrate (Unit : *g*)

Material	Ratio of substitution			
	Control (A)	30%(B)	50%(C)	70%(D)
Minced beef	200	140	100	60
Rehydrated MT-FPC	0	60	100	140
Onion	100	100	100	100
Bread crumb	80	80	80	80
Milk(ml)	25	25	25	25
Egg white	15	15	15	15
Salt	4	4	4	4
Pepper	0.01~0.02	0.01~0.02	0.01~0.02	0.01~0.02
Monosodium glutamate	0.01~0.02	0.01~0.02	0.01~0.02	0.01~0.02
Starch	5	5	5	5

texture of MT-FPC, however, was the same as that of beef meat. Therefore, MT-FPC could be utilized substitution goods for beef meat cooking.

Sensory evaluation

Model hamburger and fried meat balls were prepared according to the formula shown in Table 5 and 6. Sensory evaluation of fried meat balls and hamburger for taste, odor and texture is shown in Fig. 2 and 3. Beef meat could be substituted with MT-FPC up to 50% in processing model hamburger and fried meat balls without any significant loss of taste, odor and texture. According to the report of

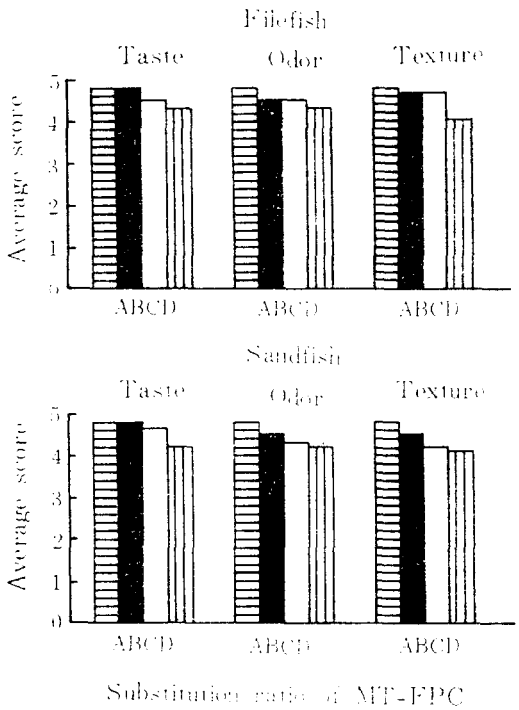

Fig. 2. Sensory score of hamburger supplemented with meanty textured fish protein concentrate
A.B.C.D: refer to Table 5.

Okazaki *et al.*[11], a sensory evaluation of the hamburger steaks containing the rehydrated MT-FPC showed that MT-FPC can be replaced livestock meat as much as 70%. Lee and Kim[1] reported that beef meat could be substituted with MT-FPC as much as 50 ot 70% for materials of hamburger, meat balls and meat buns.

Table 6. Formular for fried meat ball preparation with meaty textured fish protein concentrate (Unit : *g*)

Material	Ratio of substitution			
	Control (A)	30%(B)	50%(C)	70%(D)
Minced beef	50	35	25	15
Rehydrated textured FPC	0	15	25	35
Bean curd	20	20	20	20
Onion	2	2	2	2
Salt	0.2	0.2	0.2	0.2
Pepper	0.01~0.02	0.01~0.02	0.01~0.02	0.01~0.02

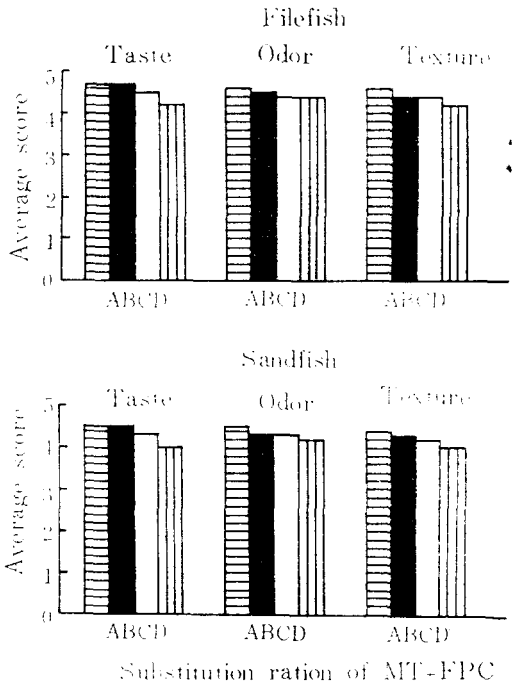

Fig. 3. Sensory score of fried meat ball supplemented with meaty textured fish protein concentrate
A.B,C,D: refer to Table 6

요 약

말취치 및 도루묵을 보다 효과적으로 이용하기 위하여, 축육과 유사한 텍스쳐를 가진 어육단백질농축물 저장 중의 품질 안정성 및 이용방안에 대하여 검토하였다.

제품은 함기포장하여 상온에 저장하여도 복수성,

TBA값 및 갈변도 등에 큰 변화없이 90일간 품질이 안정하게 유지되었다.

햄버어그 및 튀김어단을 만들때 쇠고기 대신에 축육과 유사한 텍스쳐를 가진 어육단백질농축물을 50%까지 섞어도 맛, 냄새 및 텍스칙 등에 별다른 손색이 없었다.

References

1. Lee, E. H. and Kim, S. K.: *Bull. Korean Fish. Soc.*, **12**, 103 (1979)
2. Lee, E. H., Han, B. H., Lee, K. T., Kim, S. K. and Cho, D. J.: *Bull. Fish. Res. Dev. Agency*, **26**, 63 (1981)
3. Lee, E. H., Sudibjono and Kim, S. K.: *Korean J. Food Sci. Technol.*, **11**, 232 (1979)
4. Lee, E. H., Cho, D. J., Kim, S. K. and Han, B. H.: *Korean J. Food Sci. Technol.*, **14** (1982)
5. Tarladgis, B. G., Watts, B. M. and Younathan, M. T.: *J. Am. Oil Chem. Soc.*, **37**, 44 (1960)
6. Toyomizu, M. and Chung, C. Y.: *Bull. Jap. Soc. Sci. Fish*,, **34**, 875 (1968)
7. Suzuki, T., Karra, K., Okazaki, E. and Morita, N.: *Bull. Jap. Soc. Fish.*, **44**, 1275 (1978)
8. Kim, M. N., Choi, H. Y. and Lee, K. H.: *J Korean Soc. Food Nutr.*, **2**, 41 (1973)
9. Byun, D. S., Song, Y. O. and Pyeun, J. H.: *Korean J. Food Sci. Technol.*, **10**, 387 (1978)
10. Fujimoto, K., Maruyama, M. and Kaneda, T.: *Bull. Jap. Soc. Fish.*, **34**, 519 (1968)
11. Suzuki, T., Kanna, K. and Yagi, T.: *Bull. Jap. Soc. Sci. Fish.*, **44**, 781 (1978)
12. Okazaki, E., Kanna, K. and Suzuki, T.: *Bull. Jap. Soc. Sci. Fish.*, **46**, 727 (1980)