Mini Review

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The composition and health benefits of mackerel concentrate

Abstract

The objective of this study was to study the protein profile and amino acid composition of the mackerel concentrates from fish meat protein processed by enzymatic hydrolysis and then treated by high pressure-low temperature concentration. Mackerel peptide was prepared and health benefits were analyzed by human subject research. The results showed that the mackerel concentrates had significantly higher MW<10kDa peptide than the cooking juice remained. The concentrate contained abundant branched chain amino acids and taurine that related to anti-fatigue activity. Quality-of-Life (QOL) improvement and antihypertensive effect of mackerel concentrate were also proven. This study suggested that mackerel hydrolyzate may potentially serve as a good source of healthy oligopeptide and could be transformed into novel value-added functional food supplement.

Keywords: amino acid, antihypertensive activity, hydrolysate, mackerel, peptide

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Yi-Huang Chang,[1] Wenni Huang,[2] Hong-Jun Chen,[1] Chih-Cheng Lin[2]

[1]Department of Food Science, Yuanpei University of Medical Technology, Taiwan

[2]Department of Biotechnology and Pharmaceutical Technology, Yuanpei University of Medical Technology, Taiwan

Correspondence: Chih-Cheng Lin, Department of Biotechnology and Pharmaceutical Technology, Yuanpei University of Medical Technology, No. 306, Yuanpei Street, Hsinchu, Taiwan, Tel 886-3-5381183 ext 2201, Fax 886-3-5401480, Email lcc@mail.ypu.edu.tw

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Introduction

Mackerel is a special fish species near the inshore area around Taiwan. Though with extremely high oil content, mackerel is abundant in ω-3 polyunsaturated fatty acid. In addition, mackerel is also rich in biologically active amino acids and protein.[1] Mackerel dark meat has limited uses due to its accessibility to oxidation and off-flavor. It is usually processed into low market-value products. Therefore, development of this protein rich meat into protein hydrolysates for further utilization may create highly valuable products.[2,3] Fish protein hydrolysate is a breakdown product of fish meat with proteolytic enzymes under controlled conditions of pH and temperatures containing smaller peptides and amino acids. Fish protein hydrolysates have attracted much attention due to the availability of large quantities of raw material after the process, and presence of high smaller protein content with biological active amino acids and peptides that exhibited antioxidant and antihypertensive activities.[4–6]

Materials and methods

Mackerel concentrate was provided from YOUNEED international Co. Ltd. The mackerel was caught in Suao, Taiwan. Fresh mackerel was filleted and hydrolyzed by adding papain. Then mackerel concentrate was produced by using the low-temperature extraction technology of Taiwan Sugar Biotechnology.

The α-amino nitrogen analysis of mackerel concentrate was determined according to the method of Sun et al.[7] Braford protein assay was used for quantitative determination of the total protein.[8] Hydrolyzed and free amino acid compositions were analyzed according to the method of AOAC.

For human subject research, five healthy adult volunteers (4 male and 1 female) who do not smoke or drink alcoholic beverages, ranging from 22 to 60years of age and 60-80kg in weight, participated in the study. The subjects did not ingest fish for at least 2days prior to the experiment. The volunteers ingested a bottle of mackerel concentrate drink after breakfast. A 63ml of concentrate per bottle is equivalent to the protein contained in eight fish. Quality-of-life (QOL) questionnaires (scores ranged from 1 to 5) were completed and blood pressures were measured in ingestion of mackerel concentrate for one month. Informed consent was obtained for all participants, and the study was approved by the IRB reviewed.

Results and discussion

Mackerel concentrate, which processed from enzyme hydrolysis and extraction, contained more trace protein than those in the cooking juice (Table 1). Further, it was found that no lipid and cholesterol was detected in the mackerel concentrate. From the results of the α-amino nitrogen and total protein analysis in Table 1, the constituents of mackerel concentrate were mainly short peptides and amino acid, accounting for 98.5% of the total weight. In addition, these short peptides and amino acid molecules with molecular weights less than 3kDa accounted for 36.2% of the total protein (Table 2). Wu et al.[1] described protein hydrolysates from mackerel meat by an autolytic process and accelerated hydrolysis with protease. Their results also found increased levels of free amino acids and small peptides during hydrolysis.

Table 1 Protein profile of mackerel cooking juice and concentrate

	Concentration (g/L)	
	Cooking juice	**Hydrolysate**
Protein	2.55	0.229
α-amino nitrogen	3	15.6

Table 2 Protein size distribution of mackerel concentrate

Molecular size (kDa)	Percentage (%)
< 3	36.2
3–10	35.8
>10	27.9

The hydrolyzed amino acid composition of protein is mainly glutamic acid, lysine, aspartic acid, histidine, arginine (Table 3). Glutamic acid and arginine supplementation have been recognized to improve fatigue.[9,10] It is interesting that mackerel concentrate contained abundant anti-fatigue branched-chain amino acid and taurine except glutamic acid and arginine as shown in Table 4. Questionnaires on quality of life (QOL) were also performed in a human subject research and the results are shown in Table 5. A higher QOL score indicated higher satisfaction. It was found that drinking a total of 62mL of mackerel concentrate daily for 30 consecutive days, the subject's both quality of sleep and quality of energy were all positively improved (Table 5).

Table 3 Top twelve hydrolyzed amino acids in mackerel concentrate

Amino acid	Concentration (mg/kg)
Glutamic Acid	6842
Lysine	4280
Aspartic Acid	4103
Histidine	3943
Arginine	3457
Glycine	3367
Alanine	3018
Leucine	3003
Valine	1964
Proline	1963
Threonine	1818
Isoleucine	1638

Table 4 Major free amino acids and active compounds in mackerel concentrate

Amino acid	Concentration(mg/kg)
L-Histidine	2831.0
L-Leucine	1587.5
L-Lysine	1277.8
L-Arginine	1165.2
L-Phenylalanine	868.9
L-Isoleucine	691.4
L-Valine	607.9
L-Alanine	598.9
L-Tyrosine	518.8
L-Methionine	492.8
Taurine	666.7
DL-3-Aminoisobutyric Acid	571.6
DL-2-Aminobutyric Acid	84.6
γ-Aminobutyric Acid	38.6

Table 5 QOL questionnaire score after ingested with mackerel concentrate in human subject research

item	Treatment	
	before	after
How much energy do you have to do the things you want to do?	2.4	3
How often do you have good sleeping	2.6	3.8
How satisfying are your health	2.6	3.4
Total quality of life	2.8	3.6

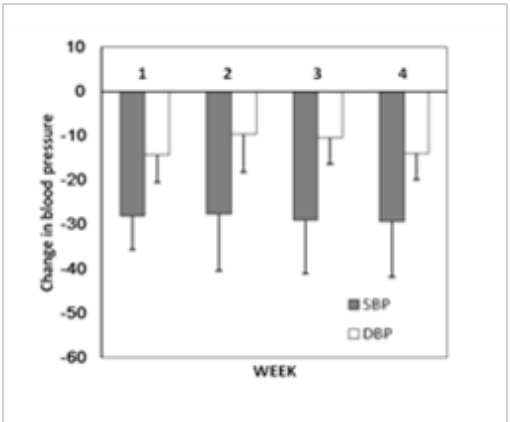

Figure 1 The antihypertensive effects of mackerel concentrate on systolic blood pressure (SBP) and diastolic blood pressure (DBP).

Figure 1 indicates that both the subjects' systolic and diastolic blood pressure decreased significantly ($p<0.05$) after consuming the mackerel concentrate drinks. The in vivo antihypertensive effects of mackerel concentrate might come from small peptide and non-protein amino acid, e.g. γ-aminobutyric acid.[11] This result was similar to those of the Lin et al. study on tilapia enzymatic hydrolysates.[12] Our results suggested mackerel meat processing products may be valuable protein raw material for producing antihypertensive peptides, anti-fatigue amino acids and taurine.

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Conflicts of interest

The author declares that there is no conflicts of interest.

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