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RESEARCH LETTER

Sensitization profile of Thai children with fish allergy

Supaluk Tangvalelerd[a], Surapon Piboonpocanun[b], Unchalee Raungsirarak[a], Manaporn Sirichuwong[a], Pakit Vichyanond[c], Punchama Pacharn[a]*

[a]*Division of Allergy and Clinical Immunology, Department of Pediatrics, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*
[b]*Institute of Molecular Biosciences, Mahidol University, Salaya Campus, Nakhon Pathom, Thailand*
[c]*Samitivej Allergy Institute, Samitivej Thonburi Hospital, Bangkok, Thailand*

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KEYWORDS
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Abstract
Introduction: Fish allergies are common food allergies, and in Thailand, the prevalence of fish allergies in children ranges from 0.29% to 1.1%. Common fish allergens include parvalbumin, enolase, and aldolase.
Method: This cross-sectional study included children with immunoglobulin E (IgE)-mediated fish allergies. The diagnosis was based on clinical history with a positive skin prick test (SPT) and/or specific IgE (sIgE). Serum IgE binding profiles to allergens in fish extracts were analyzed.
Result: Eleven children, with a median age of 3 years, were recruited; the median age of onset was 1.25 years. Cutaneous symptoms were the most frequent clinical manifestation (63.6%). Tilapia and catfish were the most common triggers. All participants showed positive SPT and/or sIgE results for fish species. The immunoblot analysis revealed IgE binding to 40–50 kDa protein in all participants, while only seven participants (63.6%) showed IgE binding to the 11 kDa protein.
Conclusion: Tilapia and catfish are the most common triggers of fish allergies in Thai children. The 40–50 kDa proteins were identified as a major fish allergen in tested cohort.

***Corresponding author**: Punchama Pacharn, MD, Associate Professor of Pediatrics, Division of Allergy and Clinical Immunology, Department of Pediatrics, Faculty of Medicine Siriraj Hospital, Mahidol University, 2 Prannok Road, Bangkoknoi, Bangkok 10700, Thailand.
Email address: punchama@gmail.com

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Introduction

Fish allergies are common food allergies worldwide, with varying prevalence across regions. In Asia, self-reported fish allergy prevalence ranges from 0.19% to 3.71%,[1] with Thailand reporting 1.1% in young children, 0.29% in older children, and some cases persisting into adulthood.[1,2] Common fish species consumed globally include cod, salmon, and tuna. Additionally, the inland Asian population typically consumes freshwater fish such as carp, tilapia, and catfish.[1] The common fish allergen, beta-parvalbumin (10–12 kDa), is abundant in fish muscle and shows extensive cross-reactivity between species.[3] Although parvalbumin exhibits high homology across fish species, its allergenicity varies; it is also influenced by the amount present in the muscle.[1] Enolases and aldolases (50 kDa and 40 kDa, respectively) are also identified as allergens in cod, salmon, catfish, and tuna.[3] Tropomyosin (33–39 kDa), a pan-allergen for shellfish, has been registered as an allergen for only one fish species—the Mozambique tilapia.[3] Collagen (130–140 kDa) has been identified as a fish allergen in the muscle and skin of raw fish. It has been found to cause monosensitization in fish-allergic patients in Japan, likely due to traditional dietary practices.[1]

A study from Hong Kong and Japan identified allergens in salmon and grass carp, with parvalbumin found to be the major allergen for both species. Collagen, aldolase, and enolase were also identified.[4] There was limited data on fish allergy in Southeast Asia. This study aimed to assess clinical characteristics, investigation, and profile of immunoglobulin E (IgE)-binding fish proteins in Thai children with fish allergies.

Methods

This cross-sectional study included children with IgE-mediated fish allergies from the allergy clinic of the Department of Pediatrics, Siriraj Hospital, and Samitivej Allergy Institute (SAI), Bangkok, Thailand, with ethical approval from Siriraj (COA no. si188/2018) and SAI Institutional Review Board (BHQ-IRB2019-02-05) during 2018–2022. The diagnosis of IgE-mediated fish allergy was made based on a clinical history of reactions within 2 hours of fish consumption and a positive skin prick test (SPT) and/or fish-specific IgE (sIgE). Clinical evaluation was conducted by pediatric allergists, including an assessment of clinical manifestations, as well as the type and severity of reactions. The SPT was performed using a mixed fish extract (flounder, cod, halibut) and salmon (ALK-Abello, Madrid, Spain). The sIgE assays were performed using ImmunoCAP (Uppsala, Sweden) for catfish, salmon, cod, tilapia, and tuna. Profiles of serum IgE binding to allergens in fish extract were obtained using the Jess capillary immunoblotting automated system (ProteinSimple; Bio-Techne, USA). Briefly, the Jess Separation Module, with a range of 12–230 kDa, was used. Twelve micrograms of extracted fish proteins were electrophoretically separated according to their molecular weight in each capillary. Serum from both allergic and nonallergic individuals was diluted at a 4:1 ratio in diluent buffer and added to each capillary individually. The allergens bound by serum IgE were detected using a horseradish peroxidase (HRP)-conjugated goat anti-human IgE antibody. Digital images of chemiluminescence from the capillary were captured using the Compass Simple Western software (version 6.1.0, Protein Simple).

Results

Eleven children were enrolled. Demographic data of the participants are shown in Table 1. The median age was 3 years (range: 2–16 years) and the age of onset was 1.25 years (range: 0.81–2.65 years). Four participants (36.4%) were male. Most of the study participants (90.9%) had concomitant atopic disease: seven (63.6%) had multiple fish allergies, and four participants (36.4%) had concomitant shellfish allergies.

The primary clinical manifestations included cutaneous symptoms (63.6%), itchy mouth/throat (27.3%), and anaphylaxis (9.1%). The most reported fish allergies were tilapia and catfish (36.4%), followed by salmon (27.3%).

Five participants had a positive result on the SPT for mixed fish and five tested positive for salmon (45.5%). However, only two of these participants (40%) had a history of adverse reactions related to salmon. Additionally, nine participants (81.8%) had positive sIgE results for fish (Table S1). Electropherograms from the capillary immunoblot analysis (Figure 1) showed all participants had IgE binding to 40–50 kDa proteins and only seven participants (63.6%) had IgE binding to the 11 kDa protein (Figure 1).

Discussion

An early age onset of fish allergy was observed, consistent with other studies in Europe and Asia.[5] Tilapia and catfish were the most common causes of fish allergy among Thai children, differing from other Asian regions, where carp, salmon, and threadfin are more common.[5] This may be explained by the high consumption rate of these foods and

Table 1 Demographic data of the study participants.

Characteristics	Fish allergy patient (n = 11)
Current age, (y), median (IQR)	3 (2, 16)
Age of onset, (y), median (IQR)	1.25 (0.81, 2.65)
Male gender, n (%)	4 (36.4%)
Atopic disease	10 (90.9%)
AD, n (%)	7 (63.6%)
AR, n (%)	8 (72.7%)
AS, n (%)	2 (18.2%)
Shellfish allergy	4 (36.4%)
Multiple fish allergy, n (%)	7 (63.6%)
Clinical manifestations of fish allergy	
Itchy mouth and throat, n (%)	3 (27.3%)
Cutaneous, n (%)	7 (63.6%)
Anaphylaxis, n (%)	1 (9.1%)

AD, atopic dermatitis; AR, allergic rhinitis; AS, asthma; IQR, interquartile range; y, years.

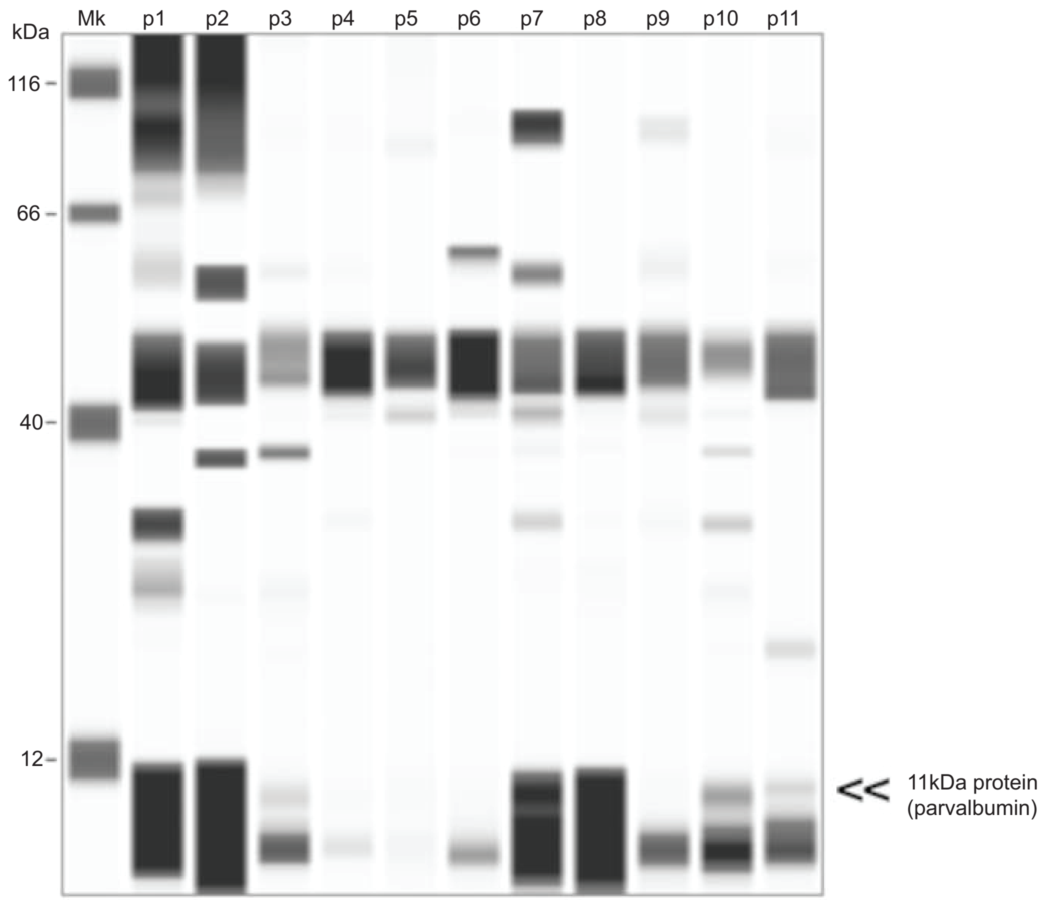

Figure 1 Profile of IgE bound fish proteins from 11 patients. This figure illustrates the IgE binding profiles of various fish proteins identified in samples from 11 patients. Each band represents a specific protein bound by IgE.

their use as an infant weaning diet. Most of our patients were allergic to multiple fish species, possibly underreported, as patients often avoid all fish species upon suspecting a fish allergy.

Most patients had mild symptoms; only one patient had a history of anaphylaxis compared to 16% in other Asian studies.[5] All participants had IgE bound to 40–50 kDa proteins. Interestingly, in this molecular weight range, two important allergens—aldolase A (40 kDa) and ß-enolase (47–50 kDa)—have been identified in cod, salmon, and tuna. It is possible that all participants had IgE, binding these two allergens of tilapia. In tilapia, the reported allergens include tropomyosin, fructose-bisphosphate aldolase A, and enolase.[3] Notably, four participants (36.4%) were parvalbumin-negative, with clinically relevant oligo-sensitization to several specific fish. Among these, three of four (75%) parvalbumin-negative patients were sensitized to catfish. A study conducted in Hong Kong and Japan revealed that parvalbumin showed an overall sensitization rate of 74.7%, followed by collagen (38.9%), aldolase (38.5%), and enolase (17.8%).[4] These findings suggest that the sensitization profile of fish-allergic individuals in Asian populations may differ from those observed in Western countries. Some participants showed relatively low levels of sIgE for certain fish allergens, which could be associated with milder symptoms or a lower predictive value of sIgE. Cross-sensitization to multiple fish species was frequently observed,[5] highlighting the complexity of fish allergy diagnosis. Importantly, a positive sensitization test does not always correlate with clinical allergy, making it critical to assess the clinical relevance before advising avoidance. An oral food challenge remains the gold standard to confirm allergy in sensitized individuals with no reported reactions. Further research is needed to identify major fish allergens in Southeast Asian populations, which will help refine diagnostic methods and improve clinical management.

This study is the first comprehensive evaluation of both clinical and immunological profiles of Thai children with fish allergies, providing essential baseline data for the region. The allergenicity of different fish species can vary significantly. The immunoblotting allowed the identification of sIgE-binding proteins, including enolase and aldolase, which are highly relevant to local fish consumption. Moreover, detection of parvalbumin-negative patients sensitized to certain fish species emphasizes the necessity for individualized approaches in allergy treatment.

This study has limitations, including a small sample size and no oral food challenge test was performed. However, all fish allergies in this study were carefully diagnosed by a pediatric allergist using a combination of clinical history, SPT, and sIgE measurements, which strengthens the reliability of the diagnosis. Furthermore, standardized extracts for SPT and sIgE are lacking for many fish species commonly consumed in Thailand, such as seabass, pomfret, mackerel, and catfish. Further research with larger sample sizes and comprehensive diagnostic tools is needed to better understand fish allergies in Southeast Asia.

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Authors Contributions

Supaluk Tangvalelerd: Conceptualization; data curation; writing—review and editing; writing—original draft. Surapon Piboonpocanun: Investigation; methodology; writing—review and editing. Unchalee Raungsirarak: Investigation. Manaporn Sirichuwong: Data collection; resources. Pakit Vichyanond: Data collection. Punchama Pacharn: Conceptualization; supervision; investigation; writing—review and editing.

Conflict of Interest

None of the authors have any conflicts of interest related to this work.

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Supplementary

Table S1 Investigation data of the study participants.

Patient no.	History	Fish Order	Skin prick test		Specific Immunoglobulin E				
			Mixed fish	Salmon	Catfish	Salmon	Cod	Tilapia	Tuna
1	Seabass	Perciformes	Neg	Neg	0.75	5.42	1.38	1.36	8.15
2	Snakeskin gourami	Perciformes	15.5	5.5	14.1	6.55	11	14.7	5.13
3	Mackerel, pomfret	Perciformes	Neg	Neg	0.45	0.65	1.01	0.53	0.76
4	Catfish, tilapia	Siluriformes Perciformes	Neg	Neg	0.23	0.03	0.06	0.39	0.03
5	Catfish, sheatfish	Siluriformes	4.5	5.0	0.01	0	0	0.01	0.06
6	Cod, tuna, grouper, salmon	Gadiformes, Perciformes Salmoniformes	6.5	5.0	0.30	0.29	0.19	0.3	0.14
7	Catfish	Siluriformes	9.0	7.0	6.9	5.2	5.31	6.93	1.2
8	Salmon, tilapia, pomfret	Salmoniformes Perciformes	15.5	16.0	22.6	20.1	17.9	22.3	1.59
9	Catfish, tilapia, mackerel	Siluriformes Perciformes	2.0	2.0	0.32	0.2	0.07	0.36	0.03
10	Salmon, tuna	Salmoniformes Perciformes	Neg	Neg	0.64	0.73	0.75	0.74	0.78
11	Tilapia	Perciformes	2.0	Neg	1.35	0.13	0.18	1.36	0.15

Neg, negative.