Joint International Symposium
Global Past, Present and Future Challenges in Risk Assessment –
Strengthening Consumer Health Protection

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Lessons learned from recent food fraud in Korea

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National Institute
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anses
French agency for food, environmental and occupational health & safety
Investigate, evaluate, protect

01 Current status

02 Domestic issues

03 Efforts we have made

04 Future Strategies

Seafood Fraud in Sushi Venue (Sushi market & restaurants)

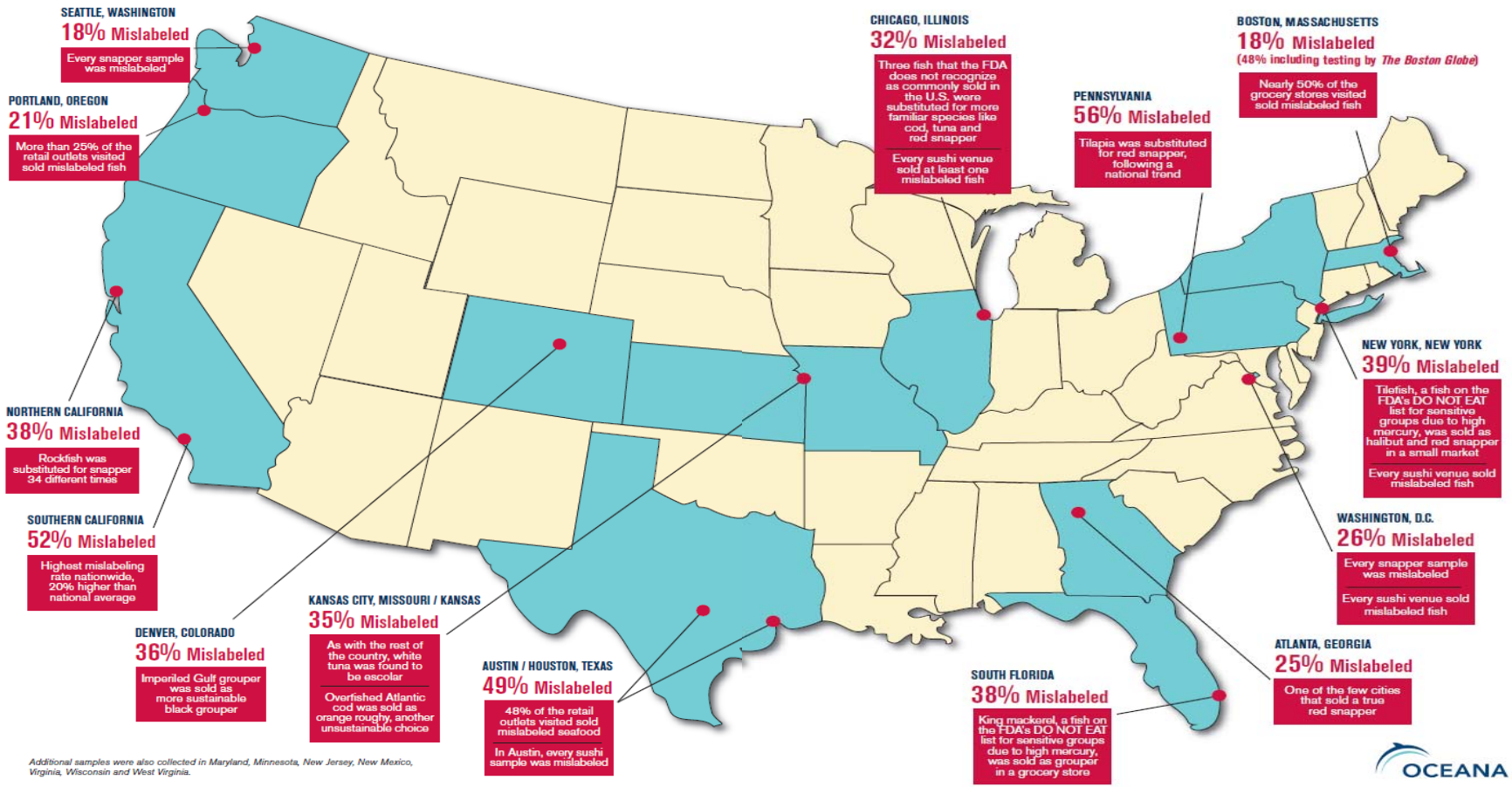
- ‘Brown Croaker’ was substituted with imported ‘Drum Fish’

[현장M출동] '민어' 샀는데 '점성어'가? 못 믿을 수산시장

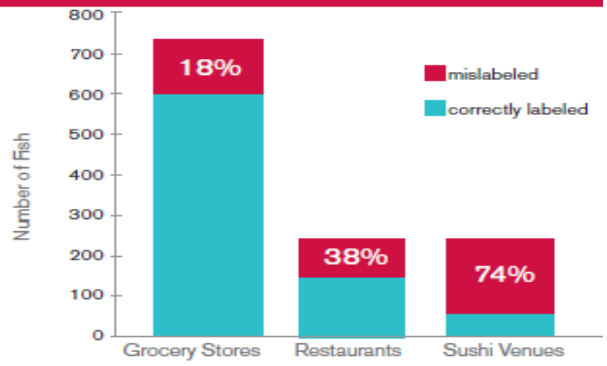
정준희 | 기사입력 2017-08-02 20:27 | 최종수정 2017-08-02 21:31

생선회 수산시장 민어 어시장 자연산 양식 바꿔치기

‘OCEANA’ found 1/3 seafood samples mislabeled in US



Mislabeling by Retail Outlet



KEY RESULTS

- Mislabeling was found in 27 of the 46 fish types tested (59%).
- Salmon, snapper, cod, tuna, sole, halibut and grouper were the top collected fish types.
- Snapper (87%) and tuna (59%) were the most commonly mislabeled fish types.
- Only seven of the 120 red snapper samples were honestly labeled.
- Between one-fifth to more than one-third of the halibut, grouper, cod and Chilean seabass samples were mislabeled.
- 44% of all the grocery stores, restaurants and sushi venues visited sold mislabeled seafood.
- 84% of the white tuna samples were actually escolar, a species that can cause serious digestive issues for some individuals who eat more than a few ounces.

Commonly Mislabeled Fish

What You Bought	What You Got
Chilean seabass	Antarctic toothfish
Alaskan/Pacific cod	Pangasius (Asian "catfish"), Atlantic cod, threadfin slickhead, tilapia
Atlantic cod	Pacific cod, white hake
grouper	Pangasius (Asian "catfish"), king mackerel, whitefin weakfish
Alaskan/Pacific halibut	Atlantic halibut, blueline tilefish
salmon (wild, king and sockeye)	farmed Atlantic salmon
sea bass	Antarctic toothfish, Patagonian toothfish
snapper	giltheaded seabream, madai, tilapia, Pacific ocean perch, widow rockfish, yellowtail rockfish
red snapper	Caribbean red snapper, crimson snapper, spotted rose snapper, Pacific ocean perch, yellowtail rockfish, giltheaded seabream, madai, tilapia, white bass
lemon sole	blackback flounder, summer flounder, flathead sole, yellowfin sole
white tuna	escolar

어류용어

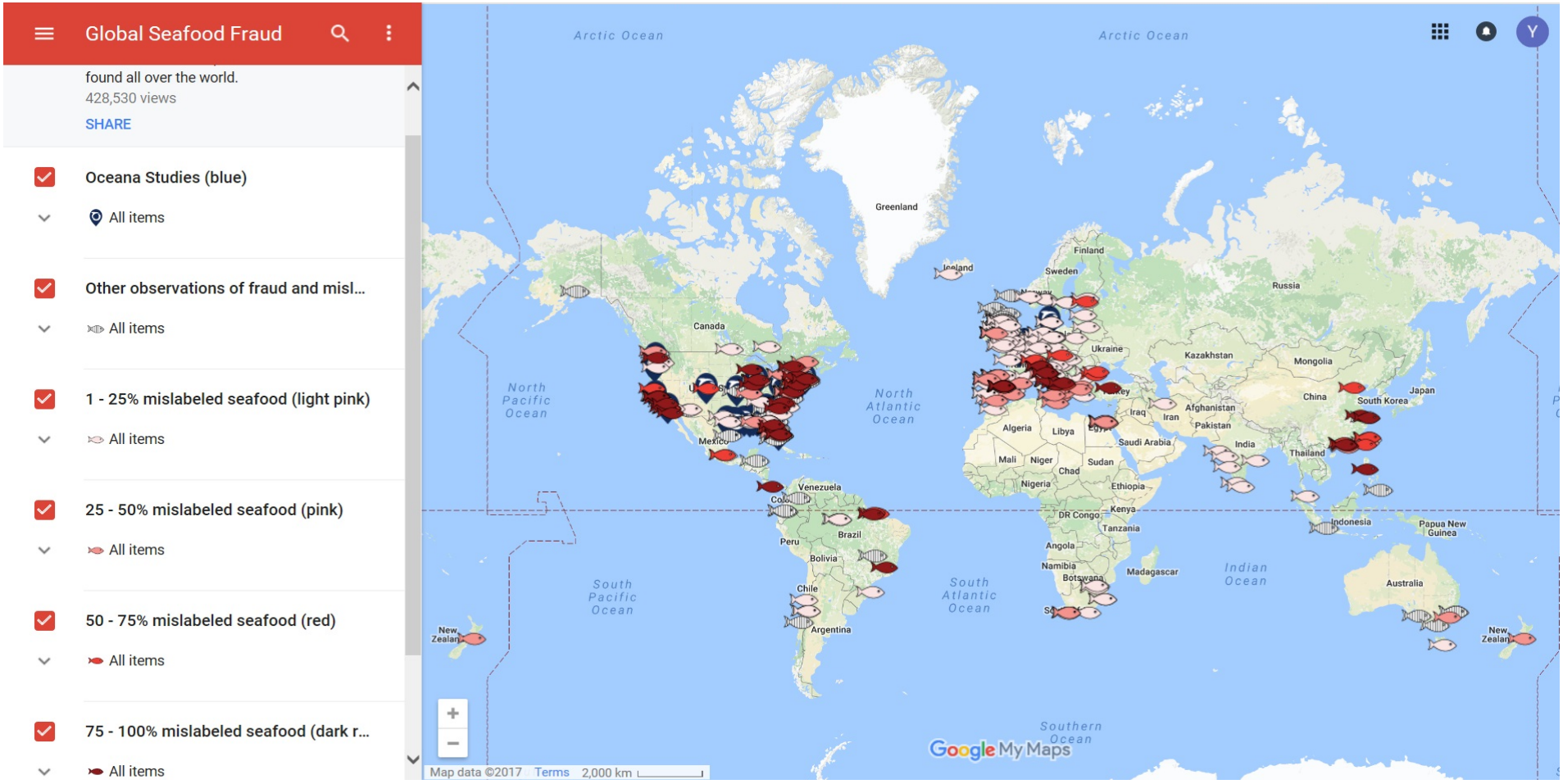
Seabass : 농어
Toothfish: 메로
Cod: 대구
Hake: 대구류

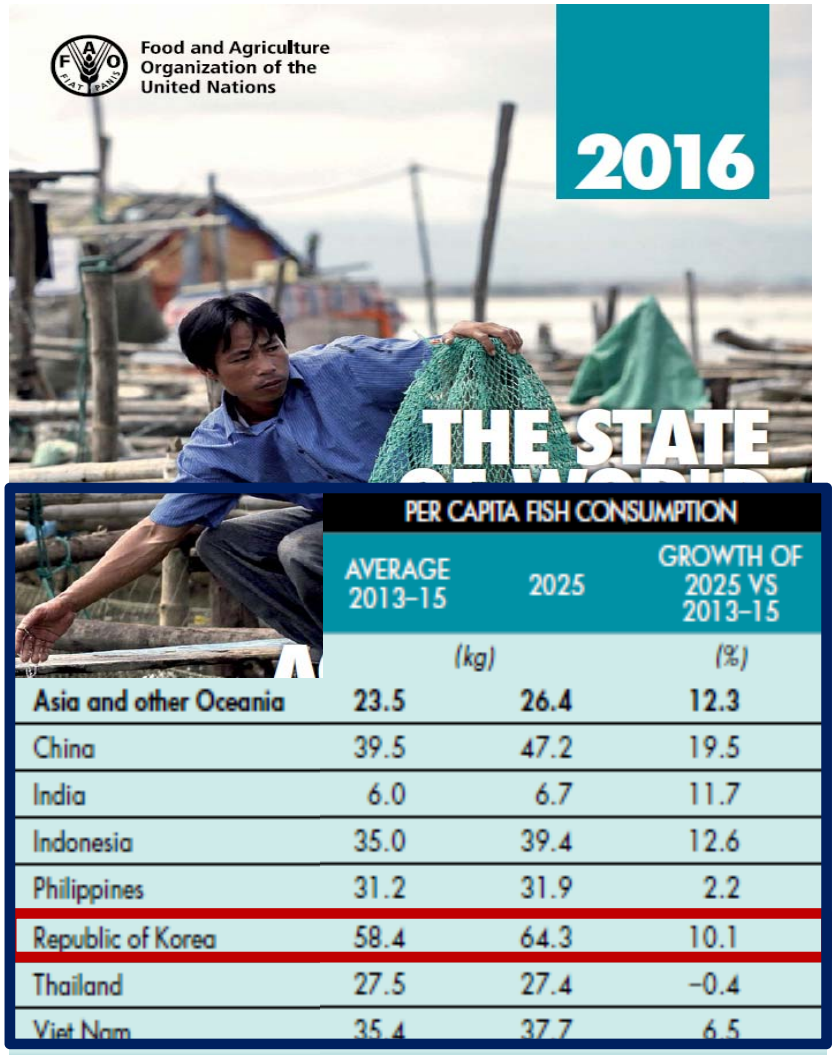
Grouper : 바리과
Pangasius: 아시아메기
King mackerel: 삼치류
Halibut: 넙치
Tilefish : 옥돔류

(Red) Snapper: (붉돔)도미류
Seabream: 도미류
Rockfish: 우럭
Tilapia: 역돔

Sole : 서대기
Flounder : 도다리
Escolar: 기름갈치꼬치

Global seafood fraud map from OCEANA.org





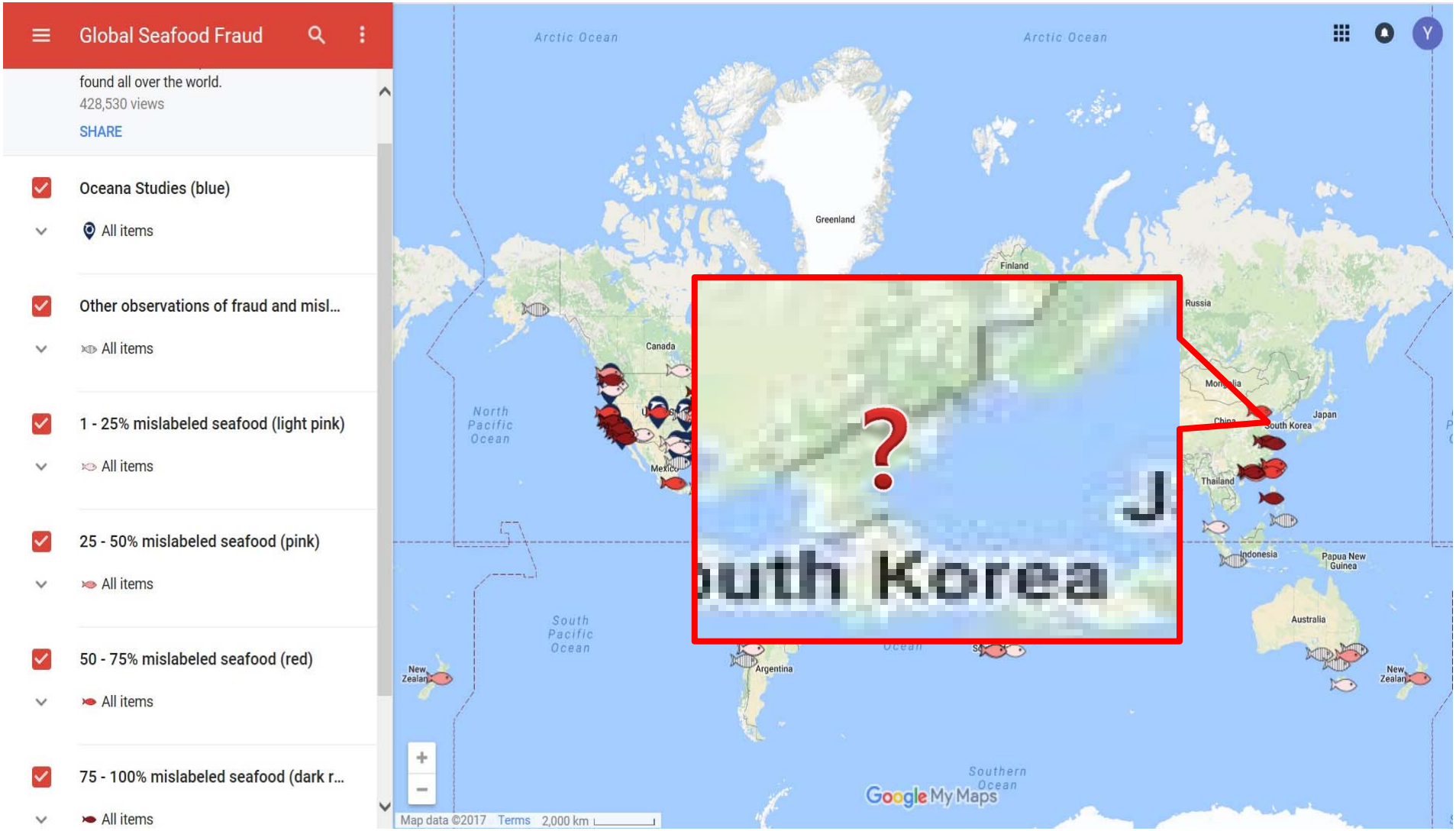
PER CAPITA FISH CONSUMPTION	AVERAGE 2013–15	2025	GROWTH OF 2025 VS 2013–15
	(kg)		(%)
Asia and other Oceania	**23.5**	**26.4**	**12.3**
China	39.5	47.2	19.5
India	6.0	6.7	11.7
Indonesia	35.0	39.4	12.6
Philippines	31.2	31.9	2.2
Republic of Korea	58.4	64.3	10.1
Thailand	27.5	27.4	–0.4
Viet Nam	35.4	37.7	6.5

TABLE 23

MAIN RESULTS OF THE FISH MODEL: COMPARISON 2025 VS 2013–15: FOOD FISH SUPPLY (LIVE WEIGHT EQUIVALENT)

	FOOD FISH SUPPLY			PER CAPITA FISH CONSUMPTION		
	AVERAGE 2013–15	2025	GROWTH OF 2025 VS 2013–15	AVERAGE 2013–15	2025	GROWTH OF 2025 VS 2013–15
	(Thousand tonnes)		(%)	(kg)		(%)
WORLD	**146 648**	**177 679**	**21.2**	**20.2**	**21.8**	**7.9**
DEVELOPED COUNTRIES	**31 917**	**33 950**	**6.4**	**22.7**	**23.4**	**3.1**
North America	**8 381**	**9 339**	**11.4**	**23.6**	**24.3**	**3.0**
Canada	801	851	6.2	22.5	21.8	–3.1
United States of America	7 580	8 488	12.0	23.7	24.6	3.8
Europe	**15 568**	**16 605**	**6.7**	**20.8**	**22.2**	**6.7**
European Union	11 082	12 181	9.9	22.0	23.9	8.6
Norway	274	317	15.7	53.3	55.3	3.8
Russian Federation	3 171	2 979	–6.1	22.1	21.1	–4.5
Oceania developed	**760**	**1 014**	**33.4**	**27.0**	**31.7**	**17.4**
Australia	646	893	38.2	27.3	33.0	20.9
New Zealand	115	122	6.1	25.5	24.7	–3.1
Other developed	**7 207**	**6 992**	**–3.0**	**26.5**	**24.6**	**–7.2**
Japan	6 362	6 035	–5.1	50.2	49.1	–2.2
South Africa	417	430	3.1	7.7	7.4	–3.9
DEVELOPING COUNTRIES	**114 732**	**143 730**	**25.3**	**19.6**	**21.5**	**9.7**
Africa	**10 881**	**14 655**	**34.7**	**10.0**	**10.2**	**2.0**
North Africa	*2 803*	*3 553*	*26.8*	*15.6*	*16.7*	*7.1*
Egypt	1 875	2 446	30.5	20.9	22.5	7.7
Sub-Saharan Africa	*8 078*	*11 102*	*37.4*	*8.9*	*9.1*	*2.2*
Ghana	639	656	2.7	23.9	19.5	–18.4
Nigeria	2 097	2 910	38.8	11.8	12.5	5.9
Latin America and Caribbean	**6 302**	**8 476**	**34.5**	**10.0**	**12.2**	**22.0**
Argentina	207	192	–7.2	4.8	4.0	–16.7
Brazil	1 972	2 841	44.1	9.6	12.7	32.3
Chile	253	314	24.1	14.2	16.0	12.7
Mexico	1 610	2 117	31.5	12.8	14.9	16.4
Peru	675	969	43.6	21.9	27.6	26.0
Asia and other Oceania	**97 549**	**[illegible]**	**23.6**	**23.5**	**26.4**	**12.3**
China	54 128	66 747	[illegible]	39.5	47.2	19.5
India	7 755	9 758	25.8	6.0	6.7	11.7
Indonesia	8 896	11 206	26.0	35.0	39.4	12.6
Philippines	3 091	3 703	19.8	31.2	31.9	2.2
Republic of Korea	2 924	3 340	14.2	58.4	64.3	10.1
Thailand	1 859	1 879	1.1	27.5	27.4	–0.4
Viet Nam	3 275	3 846	17.4	35.4	37.7	6.5
LEAST-DEVELOPED COUNTRIES	**12 170**	**15 978**	**31.3**	**13.2**	**13.6**	**3.0**
OECD[1]	**32 314**	**35 410**	**9.6**	**24.7**	**25.8**	**4.5**

[1] Organisation for Economic Co-operation and Development.
Source: OECD and FAO.


Global Seafood Fraud
found all over the world.
428,530 views
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Oceana Studies (blue)
All items
Other observations of fraud and misl...
All items
1 - 25% mislabeled seafood (light pink)
All items
25 - 50% mislabeled seafood (pink)
All items
50 - 75% mislabeled seafood (red)
All items
75 - 100% mislabeled seafood (dark r...
All items
Arctic Ocean
Arctic Ocean
Greenland
Finland
Russia
Canada
North Pacific Ocean
Mexico
Japan
South Korea
Thailand
Indonesia
Papua New Guinea
Australia
South Pacific Ocean
Argentina
New Zealand
Southern Ocean
Google My Maps
Map data ©2017 Terms 2,000 km

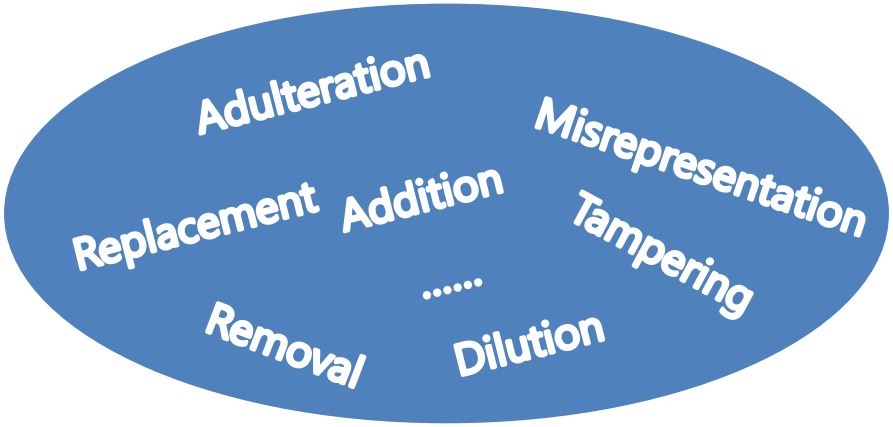
WHICH ONE IS AUTHENTIC?

11 most fraudulent foods?

Source: CRS compilation from information reported by USP, Michigan State University, NCFPD










Issues worldwide

Horsemeat Scandal (2013)

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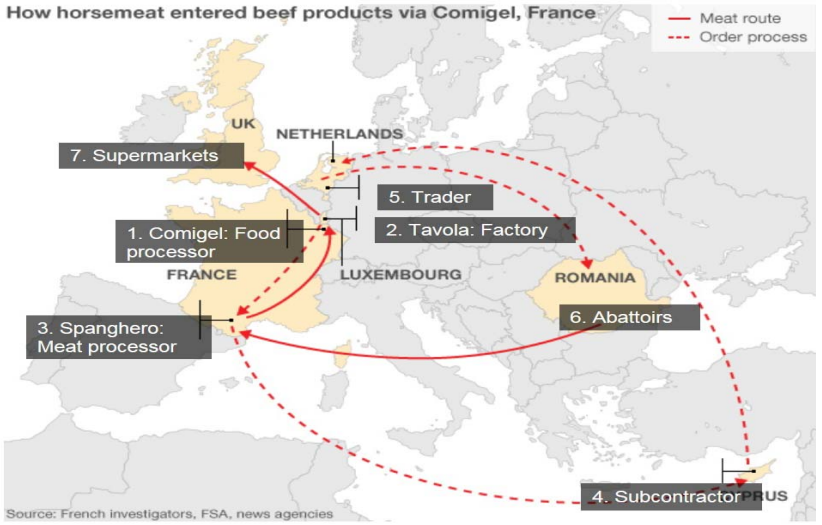
Q&A: Horsemeat scandal

10 April 2013 | UK

Share

The discovery of horsemeat in processed beef products sold by a number of UK supermarket chains last month has resulted in a series of product recalls and thrown the spotlight on the food industry's supply chain. It has also inspired a stricter food testing regime across Europe. So how did the scandal unfold and what is being done?



Issues worldwide

87% of ‘Snapper’ mislabeled in US (2013)

Food Poisoning Bulletin

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You are here: Home / Food Safety / Oceana Finds Seafood Fraud Worldwide

Oceana Finds Seafood Fraud Worldwide

September 8, 2016 by Linda Larsen

Oceana has released a report about seafood fraud around the world. The report, called Deceptive Dishes: Seafood Swaps Found Worldwide, states that seafood fraud is a serious global problem that threatens consumer health.

Issues worldwide

A big department store was revealed to have sold mislabeled food materials in Japan (2013)

‘Kuruma prawn’

‘Black tiger prawn’

Proposal on New Work in CODEX …

'Food fraud'

'Food integrity'

'FOOD AUTHENTICITY'

'Economically Motivated Adulteration'

what's the DEFINITION?

Taking a decision on the need for new work depending on EWG (23rd CCFICS, 2017)

Legal Definition of ‘Food Fraud’?

There is ‘No statutory definition’

- **(US) ‘Economically Motivated Adulteration (EMA)’**

FDA adopted a “working definition” for an April 2009 public meeting

- **(EU) Regulation 178/2002**

Food labeling, advertising, presentation, and packaging “shall not mislead consumers.”

- **(UK) ‘Food Fraud’**

FSA describes it as “Deliberate placement on the market, for financial gain, with the intention of deceiving the consumer” : two main types - unfit and potentially harmful

- **(Korea) Food Sanitation Act**

Article 13 (Prohibition against False Labeling, etc.) (1) No one shall place any of the following false labels, exaggerated or slanderous advertisements with regard to the names, manufacturing methods, quality, nutrition facts of foods, etc., the labeling of genetically modified foods, etc. and food traceability or offer exaggerated packaging. The same shall also apply to the nutritional value, raw materials, ingredients or use of foods or food additives: <Amended by Act No. 10787, Jun. 7, 2011; Act No. 11000, Aug. 4, 2011; Act No. 14022, Feb. 3, 2016>

~omit~

2. Labels or advertisements that are not true or exaggerated;

3. Labels or advertisements that are likely to deceive or mislead consumers;

『Act on Special Measures for the Control of Public Health Crimes』

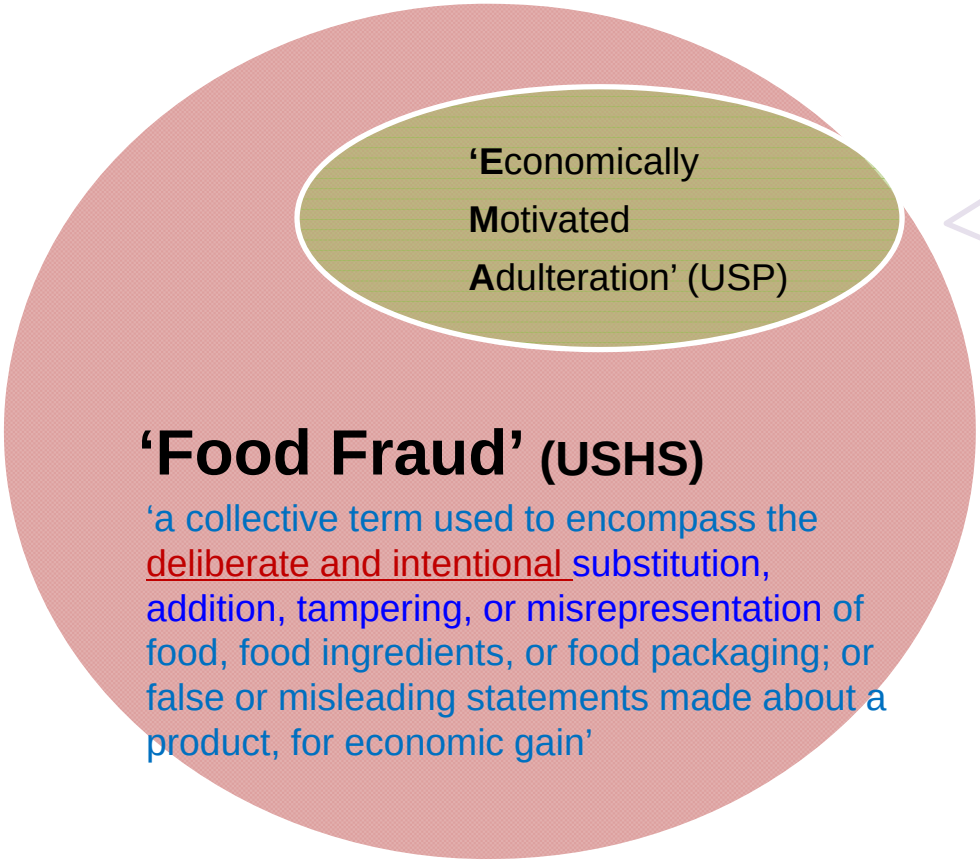
Article 2 (Punishment for Manufacturing Illegal Foods, etc.)

(1) A person who manufactures or **processes foods or additives without permission** from or report to the authorities under Article 37, a person who manufactures or processes **functional health foods without permission** in accordance with the provisions of Article 5, a person who **counterfeits or adulterates foods, additives or functional health foods** identical to those already licensed or reported, a person who, knowing such fact, sells or acquires them for the purpose of sale or offers good offices for sale, a person who manufactures or processes them in violation of each of the provisions of Articles 6 or Article 24, and a person who, knowingly, sells or acquires them for the purpose of sale or offers good offices for sale, shall be punished in accordance with the classifications set forth in the following subparagraphs:

1. Where foods, additives or functional health foods are seriously harmful to the human body, he/she shall be sentenced to imprisonment for life or for not less than five years;
2. Where the value of foods, additives or functional health foods at retail amounts to not less than 50 million won per annum, he/she shall be sentenced to imprisonment for life or for not less than three years;
3. Where a crime listed in subparagraph 1 is committed, causing the death or injury of another, he/she shall be sentenced to death penalty, imprisonment for life or for not less than five years.

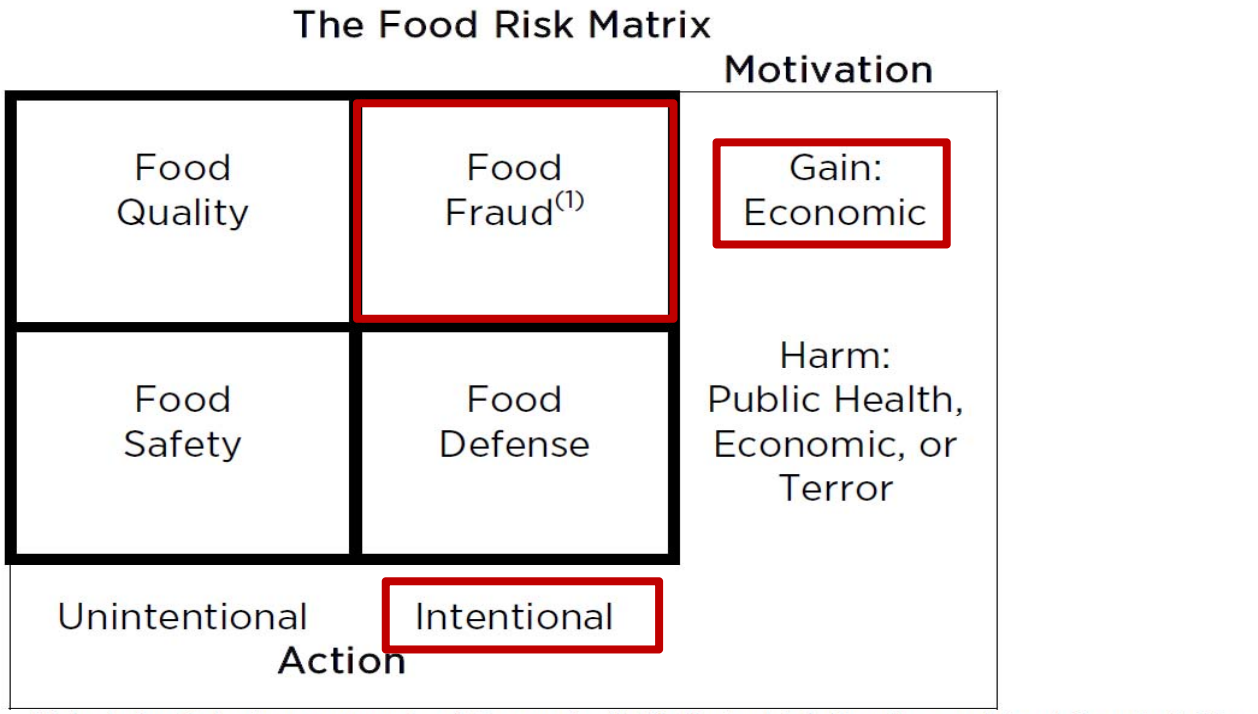
(2) In cases of paragraph (1), a fine equivalent to not less than double but not more than quintuple of the retail value of the products manufactured, processed, counterfeited, altered, acquired, sold or offered good offices for sale shall be concurrently imposed.

Working Definition?



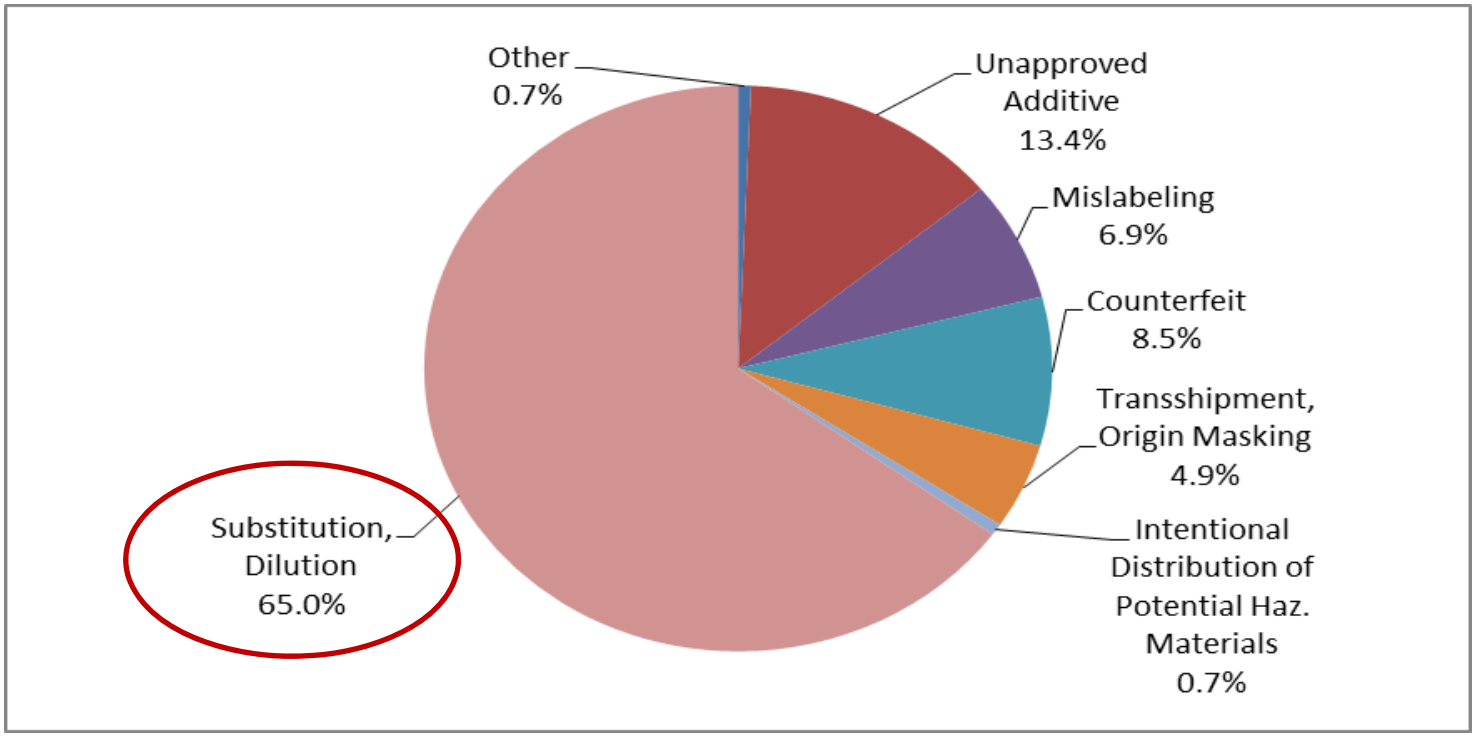
'fraudulent, intentional substitution or addition of a substance in a product for the purpose of increasing the apparent value of the product or reducing the cost of its production i.e., for economic gain'

‘Intention’ hides in action



Source : John Spink, D. Moyer, Michigan State University

EMA Incidents by Types (NCFPD, 1980-2014)



Source: Compiled by National Center for Food Protection and Defense (NCFPD) EMA Incident Database (January 6, 2014), based on 306 reported incidents.

Substitution (Replacement) includes…

- False declaration of **origin to evade taxes/tariffs**

  ex) red pepper

- False declaration of **geographic, species, botanical, or varietal origin**

  ex) white tuna

- False declaration of **production process**

  ex) honey

Source: J.C. Moore, J. Spink, and M. Lipp, “Development and Application of a Database of Food Ingredient Fraud and Economically Motivated Adulteration from 1980 to 2010,” *Journal of Food Science, Vol. 77, Nr. 4, 2012;*

Food Safety & Food Fraud in MFDS

	Organization	Law
Unintentional	• Food Safety Policy Bureau • General Food Management Division	Food Sanitation Act
		+
Intentional	• Illegal Food Eradication Bureau • Criminal Investigation Office	Special Act on Public Health Crimes

Article 2. (Punishment for Manufacturing Illegal Foods, etc.)

(1) ~ a person who **counterfeits or adulterates** foods, additives or functional health foods identical to those already licensed or reported, ~

(1) ~ a fine equivalent to **not less than double but not more than quintuple** of the retail value of the products~

01 Current state

02 Domestic issues

03 Efforts we have made

04 Future Strategies

Domestic Cases (Press Report)

Black or red seabream counterfeited with imported tilapia

SBS 뉴스 | SBS CNBC

뉴스 > 문화사회 > 문화사회

가짜 도미 '틸라피아' 썩은 물서 사는 '세균 덩어리' 날 것 먹으면 안 돼...

최종편집 : 2013-10-28 12:16:16

트위터 | 페이스북 | 미투데이 | 요즘 | 싸이월드

[SBS E! 연예뉴스팀] 가짜 도미 '틸라피아' 썩은 물서 사는 '세균 덩어리' 날 것 먹으면 안돼...

가짜 도미

소비자들이 도미로 알고 먹었던 것이 가짜 도미 '틸라피아'인 것으로 밝혀져 충격을 안기고 있다.

지난 25일 채널A의 '이영돈 PD의 먹거리 X파일'에서는 현재 대다수 식당에서 판매하고 있는 도미가 진짜 도미가 아닌 가짜 도미 민물 고기 '틸라피아'라고 폭로했다.

(Price per 2kg)
Black Sea-bream : $70

Red Sea-bream : $45

Tilapia : $20

Factor 1: Price difference

Factor 2: Similarity

Domestic Cases (Press Report)

Blueberry nectar counterfeited with imported grape nectar

Factor 1: Price difference
(Grape and Blueberry)

Factor 2: Similarity
(concentrates/nectar)

Factor 3: Repeated cases
(2010, 2013, 2014)

Domestic Cases (Press Report)

(Dried *Cynanchum wilfordii* root/ *Cynanchum auriculatum* , KBS, '15.5.27)

(*Phlomis umbrosa* Turcz/Cheonsokdan, SBS, '15.8.31)

Factor 4: Adulterate with not approved food materials

Approved	Not approved
Cynanchum wilfordii Hemsley (백수오) *Phlomis umbrosa* Turcz (한속단)	*Cynanchum auriculatum* (이엽우피소) *Dipsacus asperoides* (천속단)

01 Current state of outbreaks

02 Domestic outbreak cases

03 **Efforts we have made**

04 Future R&D

Guideline of Authentication for Food Materials since 2011

2011: 16 animals, 13 plants

2012: 25 animals, 20 plants

2013: 24 animals, 21 plants

231 Species

Animal: 123
Plants: 108

2014: 26 animals, 19 plants

2015: 22 animals, 23 plants

2016: 10 animals, 12 plants

Yr.	Animal		Plant	No.
	Terrestrial	Aquatic		
’10		Pacific cod (Alaska cod), Blue whiting, Walleye pollock (Alaska pollock), Japanese flying squid (Japanese common squid), Mitre squid	Green tea, Spinach, Chlorella spp.	8
’11	Cow, Pig, Sheep, Goat, Deer, Horse, Chicken, Duck, Turkey, Ostrich	Mozambique tilapia	Rice, Wheat, Buckwheat, Ginseng, Balloon-flower, Lance Asiabell (Bonnet bellflower), Water yam, Garlic, Onion, Radish	21
’12	Kangaroo, Goose	Common carp, Crusian carp (Buna), Chinese muddy loach, Snake head(Kamuruchi), Pacific saury, Chub mackerel, Sawedged perch, Longtooth grouper (Kelp grouper, Kelp bass), Convict grouper (Seven-banded grouper), Atlantic salmon, Cherry salmon, Abalone, Hard clam (Common orient clam), Spiny top shell, Webfoot octopus, Long arm octopus	Sweet potato, Tapioca, Black beans, Peanut, Sesame, Perilla, Olive, Sweet almond, Common Sunflower, Peach, Strawberry, Chinese bush cherry, Grape, Chinese cabbage (Napa cabage), Spring onion, Tomato, Pumpkin, Ginger, Carrot	45
‘13	Pheasant, Rabbit, Sparrow, Fox, Swallow	Amur catfish (Far eastern catfish), Golden mandarin fish (Mandarin fish), Yellow croaker, Bastard halibut (Oliver flounde), Korean rockfish (Schlegel`s black rockfish, Sebastes schlegeli), Black scraper, Anchovy, Pacific sandeel (Pacific sandlance), American lobster, Pacific sandeel, Japanese flyingfish, Capelin (Candlefish), Pacific herring, Skate ray, Sepia stingray (White ray), Japanese sea bass (Spotted sea bass), Intermedial sea urchin	Cultivated mushroom, Winter mushroom, Oak muschroom, King oyster mushroom, Oyster mushroom, Korean wasabi (Wild wasabi), Mustard, Aloe, Cucumber, Java water-dropwort, Leek, Green gram (Mung bean), Red bean, Chestnut (Korean castanea), Korean pine, Jujube, Walnut, White-flowering Korean dandelion, Korean dandelion, Guarana	45

Yr.	Animal		Plant	No.
	Terrestrial	Aquatic		
’14	Dog, Cat, Bear, Black goat, Water deer, Roe deer	Sea cucumber, Starry flounder (Diamond back), Ridged-eye flounder (Finespotted flounder), Greenland halibut, Inshore hagfish (Salad eel), Whitespotted conger (Common conger), Japanese eel (Common eel, Unagi), Dotted gizzard shad (Konoshiro gizzard shad), Common mullet (Flathead mullet, Common grey mullet), Redlip mullet (So-iny mullet, Fringelip mullet), Bobo croaker, Longneck croaker, Yellow catfish (Korean bullhead), Cheery salmon (Trout)	Tree ear, Pine mushroom, East Asian arrow root, Cheonma, Wilford's swallow-wort, AFA, Chamnamul, East Asian wildparsley, Gondre (Korean thistle), Raspberry, Black raspberry, Bokbunja (Korean blackberry), Blue berry, Black chokeberry, Acai palm (Assai palm, Acai berry)	45
’15	European polecat, Badger	Japanese sandfish (Sailfin sandfish), Finely-striate buccinum, Bladder moon snail, Japanese sardinella (Big-eyed herring), Red drum, Silver croaker (Silver jewfish), Large yellow croaker (Croceine croaker), Black sea bream, Fleshy prawn, Kuruma prawn (Kuruma shrimp), Banana prawn, Giant tiger prawn, Coonstripe shrimp(Humpback shrimp), Barramundi, Indo-pacific blue marlin, Opah, Iridescent shark, Whiteleg shrimp (Pacific white shrimp), Giant river prawn(blue robste)	Chinese artichoke, Shiny bugleweed, Silkworm thorn, American locust (Fasle acacia), Sea buckthorn, Devil's bush, Prickly castor oil tree, Japanese Angelica, Oriental raisin tree, Heartleaf Houttuynia, Lizard's tail, Balsam Pear (La-kwa, Bitter Gourd, Bitter Cucumbe), East Asian seepweed, Suaeda glauca (Asian common seepweed, Salsola asparagoides),Oriental chaff flower, Turkey tail, Japanese Maple (Palmate maple), Painted maple (Korosoe tree, Mono maple), Marshfire glasswort, Black Pepper, Parsley, Basil	45
‘16		Snow crab, Red Snow crab, Red king crab, Stone flounder, Roughscale sole, Marbled flounder, Marbled sole, Japanese amberjack, Yellowtail amberjack, Greater amberjack (Allied kingfish), Rainbow runner (Blue-striped runner)	Milk thistle, Chinese motherwort, Buckwheat, Hemp, Oat, Dwarf Pomegranate, Apple, Saffron, Marigold	22

Example

Target species	Primer name	Primer sequence (5'→3')	Size (bp)	Gene*
Snow crab	SFI16-C.opilio-F	GTATAAGCCTAGATCAAATACCA	105	COI
	SFI16-C.opilio-R	AAAGTATGGTAATTGCTCCAGC		
Red Snow crab	SFI16-C.japonicus-F	ACGAAGGTGTGCCCTTAAGA	140	ITS
	SFI16-C.japonicus-R	CACAACTAGTAACGCGTCAAC		
Red king crab	SFI16-Paralithodes-F	CCTGGGTATTTCTAGACAAGTAGA	137	Cytb
	SFI16-Paralithodes-R	CTGGATCTATTAGAGCGTATGGGA		
Stone flounder	SFI16-Kareius-F	TGCTTCTCGTTATGATAACAGCCT	168	Cytb
	SFI16-Kareius-R	TGAGGGTGGCATTATCTACAGAG		
Roughscale sole	SFI16-Clidoderma-F	TGGTCCAGTGGATTTGAGGT	162	Cytb
	SFI16-Clidoderma-R	CTGAATTTAACCCGGTGGGAT		
Marbled flounder	SFI16-Pleuronectes-F	GTCCAGTGAATTTGAGGTGG	158	Cytb
	SFI16-Pleuronectes-R	GAGTTCAGGCCGGTAGGAT		
Japanese amberjack	SFI16-S.quinqueradiata-F	GGTGTAGTCCTTCTCCTACTGTT	123	Cytb
	SFI16-S.quinqueradiata-R	TACGTAGGGAACTGCGGATAAG		
Yellowtail amberjack	SFI16-S.lalandi-F	ACTTCCTTCTCCCGTTCATCA	174	Cytb
	SFI16-S.lalandi-R	TGAGTGCAACTAGGAGAGTCG		
Greater amberjack	SFI16-S.dumerili-F	GTATCAGGCACGCCCAAAC	221	12S
	SFI16-S.dumerili-R	CGTTCGGCTTTAGTTTTGCGT		
Rainbow runner	SFI16-Elagatis-F	ACTCCAAGACAGCCTGTTTAC	174	16S
	SFI16-Elagatis-R	ATCATTGGGTTGTTGATGAGGGT		

**COI*: Cytochrome C Oxidase subunit I, *ITS* : Internal transcribed spacer, *Cytb* : Cytochrome B, *12S* : 12S ribosomal RNA, *16S* : 16S ribosomal RNA

Target species	Primer name	Primer sequence (5'→3')	Size (bp)	Gene*
Milk thistle	SFI16-Silybum-F	TCTGCGATGCCCCGTTTCGAG	110	ITS1
	SFI16-Silybum-R	AACACGAGACGCACCCTTCAT		
Chinese motherwort	SFI16-Leonurus-F	CCTGGAGTTCCACCCGAAG	140	rbcL
	SFI16-Leonurus-R	CCAAGAACAGGCTCGATGTG		
Buckwheat	SFI16-Fagopyrum-F	ATATCCACTTATCTTGCAGGAATC	167	matK
	SFI16-Fagopyrum-R	GAATCACAAAATTCTGTTGATACA		
Hemp	SFI16-Cannabis-F	GGAGTTGGCTGCGTTAATCC	163	trnL-trnF
	SFI16-Cannabis-R	CTCGTCCGATTTATCAAGTCTTC		
Oat	SFI16-Avena-F	TCAGAATTTACGCTCTATTCATTC	149	matK
	SFI16-Avena-R	ACGGAACGTCTTGTATACGG		
Dwarf Pomegranate	SFI16-Punica-F	CCACTGCCTTGTATCCACTTG	167	trnH
	SFI16-Punica-R	TTGGGTTAGGATGAATATTCTAC		
Apple	SFI16-Malus-F	GCGCGGTTGGCACAAATG	134	ITS1
	SFI16-Malus-R	CGCCGAAGCGAGAGCAG		
Saffron	SFI16-Crocus-F	TCGAGACCCGAACAAACGGA	80	ITS2
	SFI16-Crocus-R	GAGTGACGGGACGGAACG		
Marigold	SFI16-Calendula-F	GTTCCAACGGTGCGGTT	112	ITS2
	SFI16-Calendula-R	CTAGCCCATCGATGCTTAGAAC		
Sword bean	SFI16-Canavalia-F	CAACGGATATCTCGGCTCTT	190	ITS1
	SFI16-Canavalia-R	TACCTTATTGGAAAAGGCACATAG		

*ITS 1, 2 : Internal Transcribed Spacer 1, 2
rbcL : ribulose-1, 5-biphosphate carboxylase oxygenase large subunit
matK : maturase K

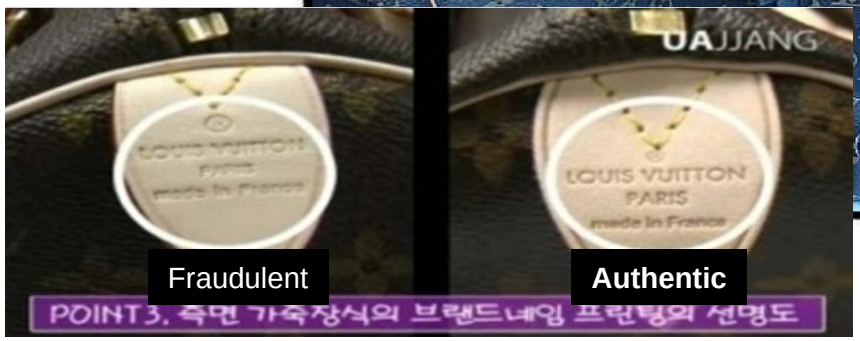
* trnL-trnF : trnL-trnF intergenic spacer
trnH : trnH intron region0

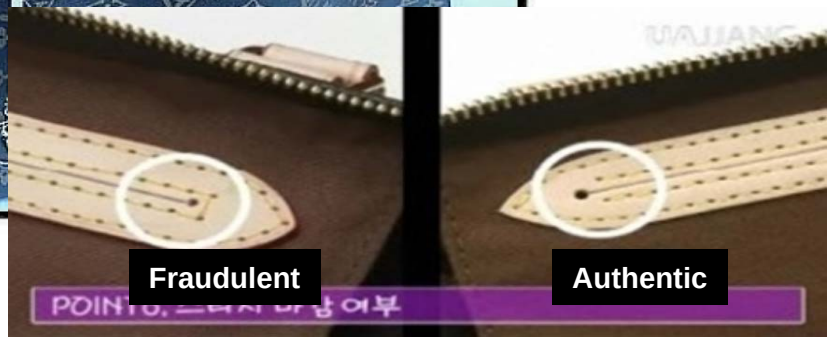

UAJJANG
Fraudulent
Authentic


UAJJANG
Fraudulent
Authentic


UAJJANG
Fraudulent
Authentic

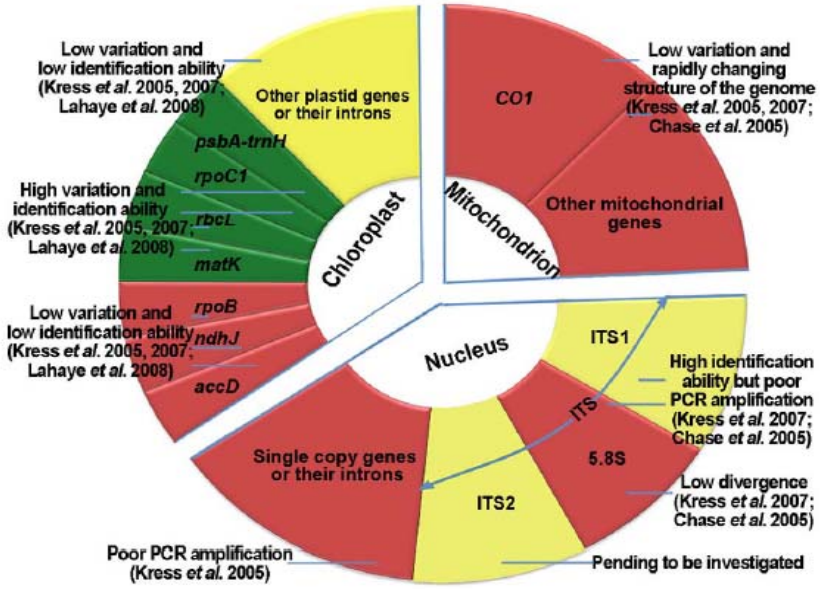

UAJJANG
Fraudulent
Authentic

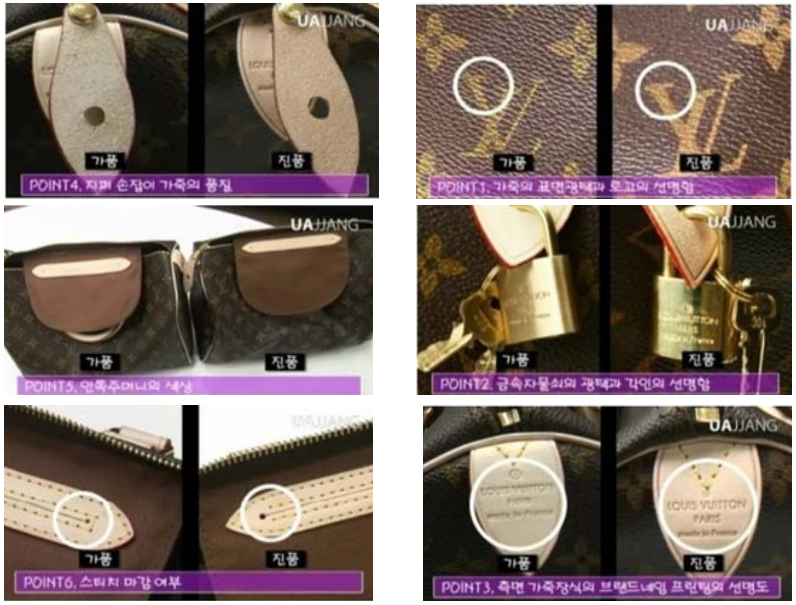

UAJJANG
LOUIS VUITTON
PARIS
made in France
Fraudulent
Authentic


Fraudulent
Authentic

DNA marker?

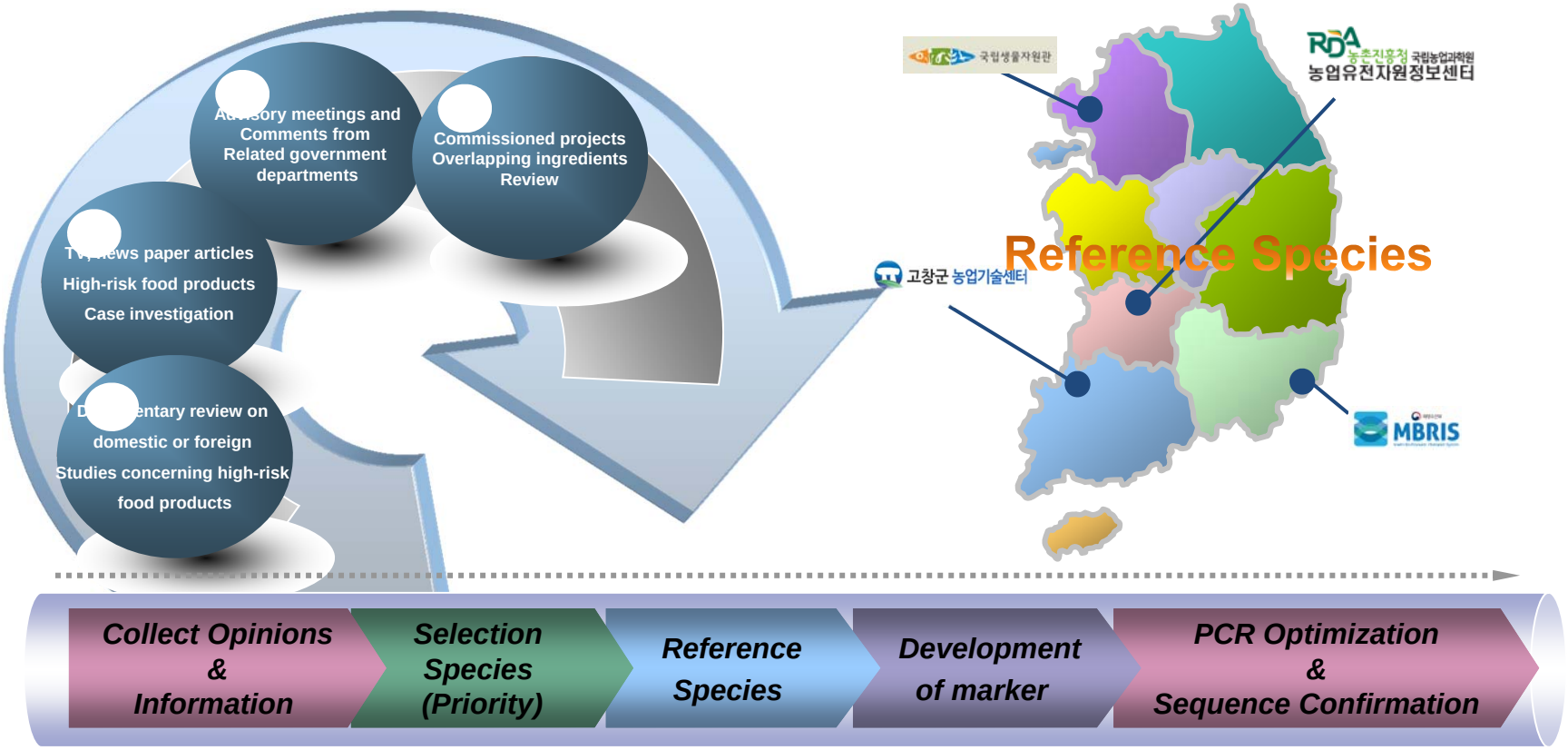
A genetic marker is a gene or **DNA sequence** with a known location on a chromosome **that can be used to identify individuals or species**





[Source: Shilin Chen *et al. Plos One*]

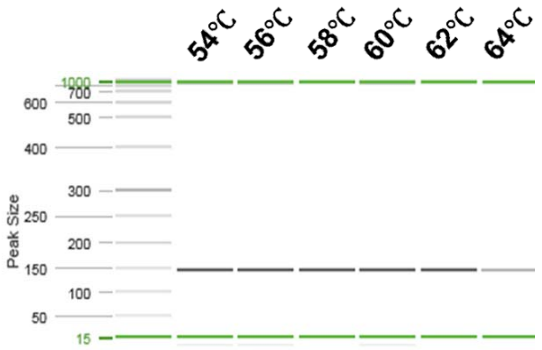
✓ Procedure for development of Species ID method



✓ PCR Optimization factor for ‘Thyme’

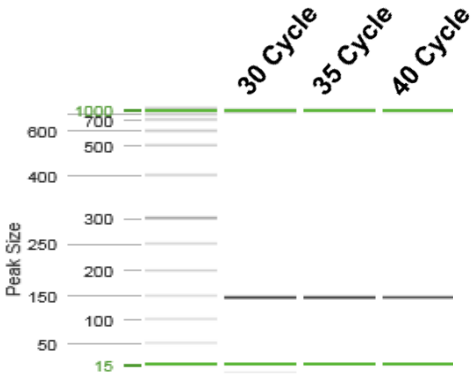
Test for …

Annealing temp.



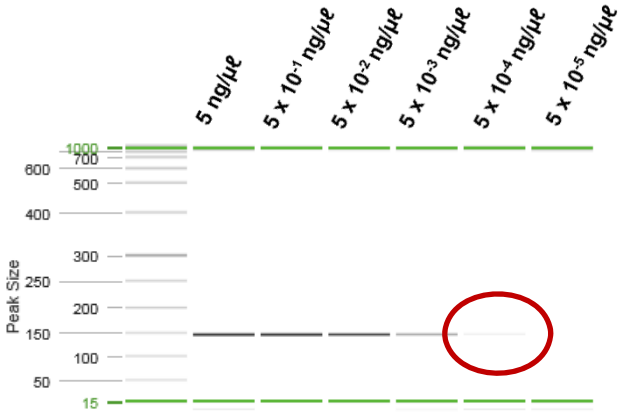
℃	54	56	58	60	62	64
Relative Con. (ng/μl)	100	100	120	120	120	80

Cycles



Cycle	30	35	40
Relative Con. (ng/μl)	200	200	200

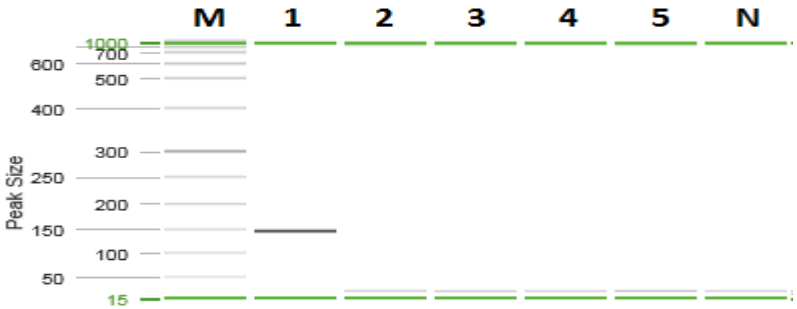
Level of detection



[Photo: Britannica Visual Dictionary ‘Thyme’]

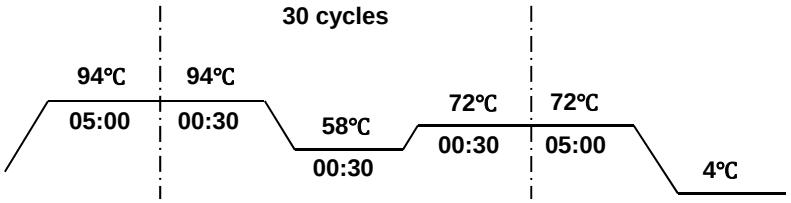
Conventional PCR Optimization for ‘Thyme’ (amplificon:145bp)

Specificity



Lane 1: Thyme
Lane 2: Oregano
Lane 3: Lemon verbena
Lane 4: Tarragon
Lane 5: Olive
Lane N: Negative Control

Optimal Condition

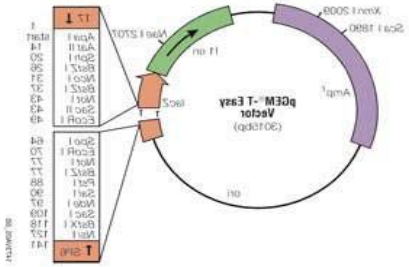


구 분	Tem.	Time	cycles
Predenaturation	94℃	5m	1
Denaturation	94℃	30s	30
Annealing	58℃	30s	
Extension	72℃	30s	
Elongation	72℃	5m	1

Sequencing and Confirmation

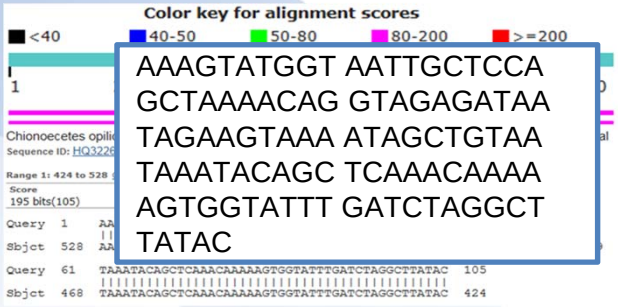
AAAGTATGGT AATTGCTCCA
GCTAAAACAG GTAGAGATAA
TAGAAGTAAA ATAGCTGTAA
TAAATACAGC TCAAACAAAA
AGTGGTATTT GATCTAGGCT
TATAC

TA cloning



Sequencing

NCBI Blast Search



AAAGTATGGT AATTGCTCCA
GCTAAAACAG GTAGAGATAA
TAGAAGTAAA ATAGCTGTAA
TAAATACAGC TCAAACAAAA
AGTGGTATTT GATCTAGGCT
TATAC

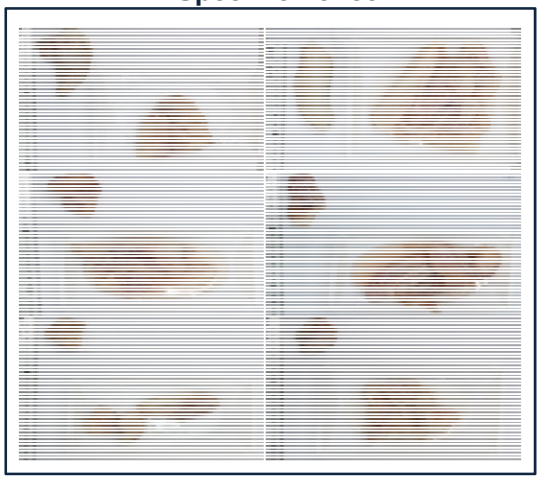
Confirm

Case study for inspection

✓ Imported sliced black mouth angler meat authentication

- Overview: A request for authentication of imported black mouth angler meat slices (June ‘14)
  - Test: Identification of the species through the sequence check in the partial CYTB
  - Result: The species was identified as *Lophius litulon*, and the result was duly advised.

1. Specimen check



2. SEQ of the partial CYTB, followed by a blast search for NCBI

TTGCTAATGACGCCCTAGTAGACCGTACCTGCCCCCTCAAACATCTCCGCATGATGAAATTTTGGGTCCCTATTAGCGCTGTGCTTAATTGCCCAAATCTTAACAGGACTATTTTTAGCTATACACT
ATACCTCTGATGTCGCCACAGCTTTCTCCTCAGTAGCACACATCTGCCGAGACGTAAACTACGGATGACTAATCCGCAACCTCCATGCAAACGGAGCCTCTTTCTTCTTTATTTGCATCTACATGC
ATATCGGACGAGGCCTCTACTACGGCTCCTACCTGTACAAAGAAACGTGGAATATTGGGGTTATCCTCCTCCTCCTAGTTATAATGACAGCATTCGTAGGATATGTTTTACCATGAGGTCAAATAT
CATTCTGAGGCGCCACAGTCATTACAAACCTACTATCTGCTGTCCCCTACATTGGCGACTCATTAGTTCAATGAATCTGAGGGGGTTTCTCAGTAGATAATGCCACCCTCACCCGATTTTTTGCCT
TCCACTTCTTATTCCCCTTTATTATTCTAGCCATGACCGTGATCCACCTCCTTTTTTTCCATGAAACGGGCTCAAATAACCCCCTAGGACTTAACTCAAACGCTGACAAAATCTCCTTCCACCCTTAT
TACTCCTACAAGGACCTTGTAGGTTTTGCAATCGTCCTAATTTCACTCACAGCCCTGGCCCTCTTTGCCCCAAACCTTTTAGGAGACCCAGACAATTTCACCCCAGCAAACCCCCTGGTCACTCC
CCCCCATATCAAGCCAGAATGATACTTCTTATTTGCTTACGCAATTTTACGCTCCATTCCCAACAAGCTGGGGGGGTGTATTAGCCTTACTTGCCTCAATCTTAGTCCTAGTGGTCGTACCCATTCTG
CACACATCAAAACAACGGGGGTCTCACCTTTCGCCCTATCACCCAATTTTTGTTCTGGACACTAGTTGCAAACGTTGCAATTTTAACTTGAATCGGAGGAATACCCGTAGAACACCCGTTTGTCATT
ATTGGACAAGCAGCATCCCTACTTTACTTCTCCCTTTTCCTAATCGCCATACCCCTTAGTTGGCGTGCAATCGAAAATAAATTCCTCGAC

Sequences producing significant alignments:

Select: All None Selected:0

Confirmed as the species “*Lophius litulon*”

Alignments | Download | GenBank | Graphics | Distance tree of results

Description	Max score	Total score	Query cover	E value	Ident	Accession
Lophius litulon mitochondrial cytb gene for cytochrome b, specimen voucher LIT12	1991	1991	100%	0.0	99%	HE608224.2
Lophius litulon mitochondrial cytb gene for cytochrome b, specimen voucher LIT13	1991	1991	100%	0.0	99%	HE608225.2
Lophius litulon mitochondrion, complete genome	1986	1986	100%	0.0	99%	KJ020931.1

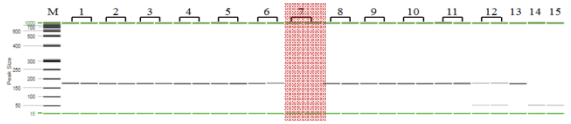
Case study for inspection

✓ Authentication of skate ray products (skate ray/ray)

- Overview: A request to confirm whether the rays are mispresented as skate rays (Mar ‘16)
  - Test: Species-specific PCR for the skate rays and sequence check on the partial COI section
  - Result: All specimens were confirmed as skate rays.

1. Specimen check

2. Species-specific PCR for skate rays

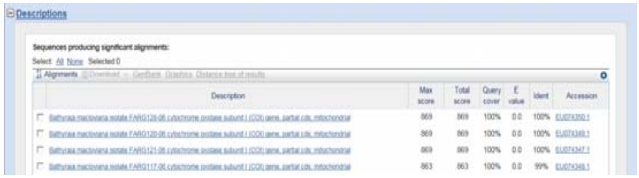


1: Skate ray sashimi
2: Samhap sashimi for restaurants
3: Mixed skate ray
4: Skate ray with cider
5: Skate ray wing meat
6: Mixed skate ray
7: Mixed skate ray sashimi
8: Yoowon skate ray sashimi
9: Home-meal mixed skate ray
10: Janchi mixed skate ray
11: Fermented skate ray meat,
12: Moksagol Top Grade Skate ray
13: Skate ray (positive control)
14: white ray
15: Negative control group

“No band could be found in the specimen No. 7”

3. SEQ check partial COI, followed by a blast search for NCBI

TGAATTAAGTCAACCTGGAACCCTTTTAGGTGATGATCAGATTTATAATGTTATTGTTACAGCCCA
CGCCCTTGTAATAATCTTCTTTATGGTTATACCAATCATAATTGGAGGTTTTGGTAATTGACTTGT
CCCTTTAATGATCGGTTCTCCAGACATAGCTTTTCCACGCATGAATAATATAAGCTTCTGACTTTT
ACCTCCATCTTTTCTTCTGCTTCTAGCCTCTGCCGGTGTTGAAGCTGGAGCGGGGACTGGCTGA
ACTGTTTATCCACCACTAGCAGGAAATCTTGCCCATGCAGGAGCTTCCGTTGATTTAACAATTTT
TTCGCTTCACTTAGCCGGTATCTCATCTATCCTAGCATCAATTAATTTTATTACTACTATCATCAAT
ATAAAACCACCAGCAATTTCACAATACCAAACACCTTTATTT



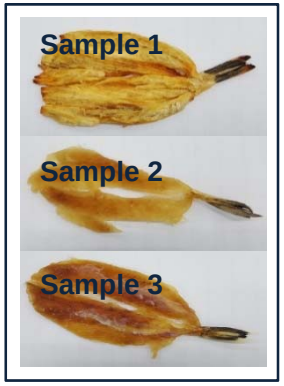
Result : Identified to be a *Rajidae fond* in the seas near Argentina, Chile, Ukraine, and Brazil.

Case study for inspection

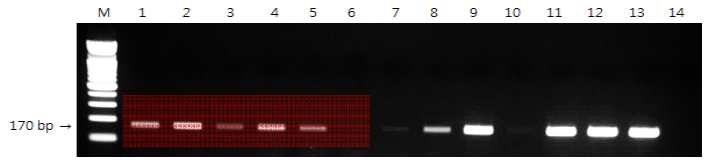
✓ Authentication of edible blowfish species in the imported seasoned and dried blowfish meat

- Overview: A request for confirmation on the imported dried blowfish meats are approved as edible (June ‘16)
  - Test: Group-specific PCR for blow fish and identify the species sequence on the partial COI
  - Result: Identified to be a species that is not permitted as one of blowfish, *Lagocephalus spadiceus*

1. Specimen check



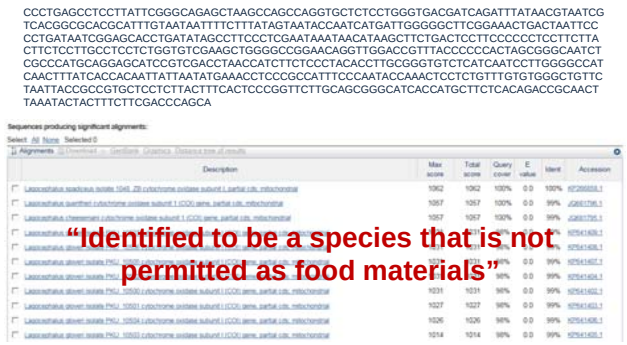
2. Perform PCRs using the universal primers for blow fish



No. 1~2; Sample (Serial number 1)
No. 3~4; Sample (Serial number 2)
No. 5~6; Sample (Serial number 3)
7; Swellfish
8; Smooth back blowfish
9; Striped puffer
10; brown-backed toadfish
11; Eyespot puffer (karasu)
12; Globe fish
13; Tiger puffer
14: Negative control group

“All specimen showed positive for blowfish primer”

3. SEQ check of the partial COI, followed by a blast search for NCBI



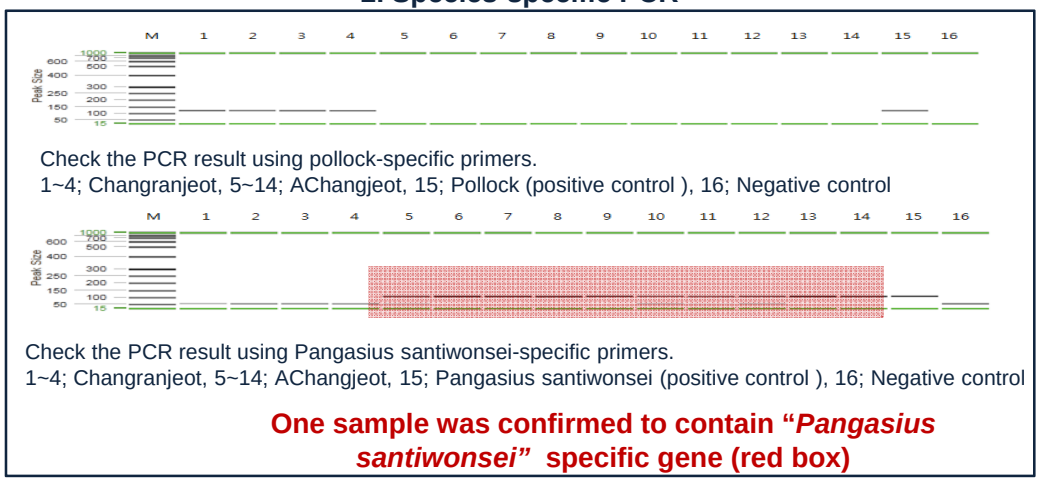
Case study for inspection

✓ Analysis of ‘changranjeot’ (fermented pollock intestine) in South Korean market to confirm the use of asian catfish

- Overview: Confirmation of the use of Pollock in ‘Changranjeot’ (July ‘16)
  - Test: PCR using specific primers of Pollock (*Theragra chalcogramma*) and *Pangasius santiwonsei*
  - Result: Identified the specific gene of *Pangasius santiwonsei* in the product

1. Sample confirmation and pre-treatment

2. Species-specific PCR



One sample was confirmed to contain “*Pangasius santiwonsei*” specific gene (red box)

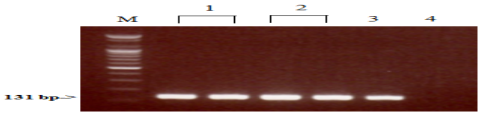
Case study for inspection

✓ Authentication of beef meat ball

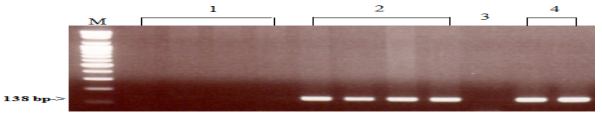
- Overview: A request for authentication of halal food (beef meat ball) to find out whether pork is mixed in the product (June ‘15)
  - Test: PCR using bovine, swine, and poultry-specific primers
  - Result: Pork and chicken meat was found in the product

1. Sample check

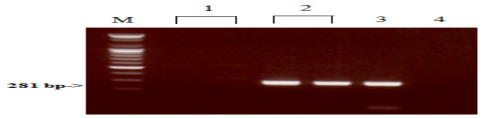
2. Perform Species-specific PCRs



Bovine-specific primer
1~2; specimen 3; beef (positive control group)
4: Negative control group



Swine-specific primer
1~2; specimen 3; Negative control group
4: Pork (positive control group)



Poultry-specific primer
1~2; specimen 3; Chicken (positive control group)
4: Negative control group

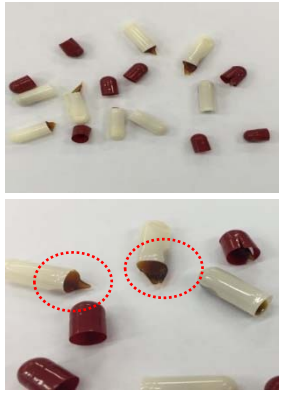
“Some specimens did contain swine and poultry genes”

Case study for inspection

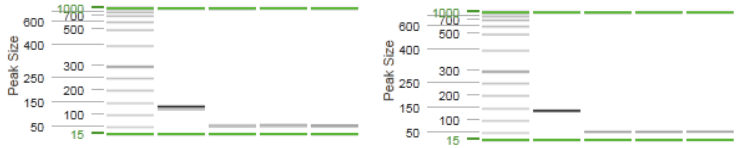
✓ Bear-bile authentication

- Overview: Confirmation of bear-bile capsules without ingredient labels (Sep ‘16)
  - Test: PCR using primers specific to bears, pigs, or cows.
  - Result: Bear genes were identified, and the bear-bile was authentic.

1. Specimen check



2. Species-specific PCR



Results of PCRs obtained from the bovine-specific (left) and swine-specific (right) primers.

1; Bovine (left, positive control), Swine (right, positive control)
2~3; Samples (capsule products)
4: Negative control group

Check the PCR result using bear-specific primers.

1~2; Samples (capsule products)
3; European brown bear
4: Asiatic black bear (positive control group),
5; Ezo brown bear
6: Negative control group

“Bear-specific genes confirmed”

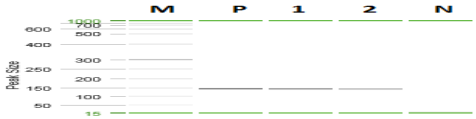
Case study for inspection

✓ Authentication of meat product for imported frozen mutton

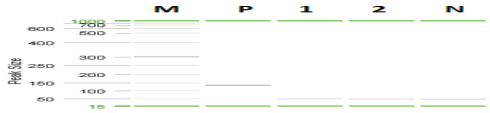
- Overview: A request for authentication of the frozen mutton (Mar ‘17)
  - Test: PCR using lamb, goat, pig, and duck-specific primers
  - Result: Identified as mutton

1. Specimen check

2. Species-specific PCR



Lamb-specific primer
P; Lamp (Positive control group), 1~2; specimens,
N; negative control group



Swine-specific primer
P; Pig (Positive control group), 1~2; specimens,
N; negative control group

“Lamb genes confirmed”

Goat-specific primer
P; Goat (Positive control group), 1~2; specimens,
N; negative control group

Duck-specific primer
P; Duck (Positive control group), 1~2; specimens,
N; negative control group

Repeated Cases

2016

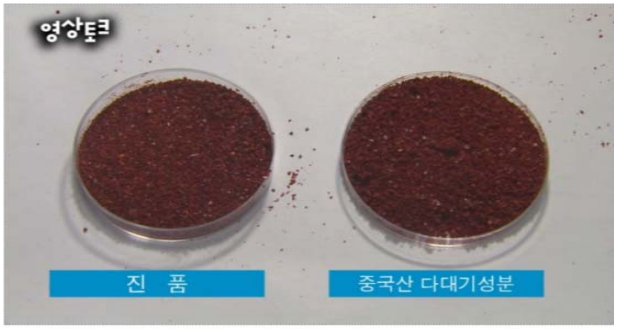
2017

- False declaration of item to reduce taxes/tariffs for economic gain

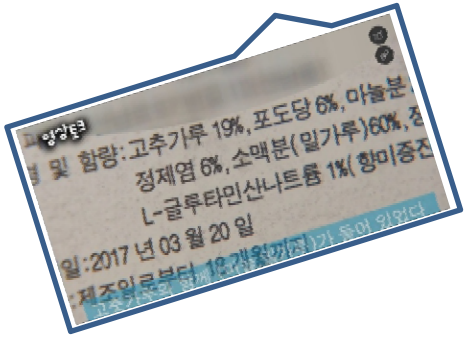
	Red Pepper Powder	Mixed Seasoning
Customs duty	**275%**	**44.5%**

False declaration of ‘Origin’ & ‘Process’

Import ‘Mixed Seasoning’ from China → **Drying** → **Grinding** → **Mixing (Pepper seed & spice)** → **Fraudulent red pepper powder**

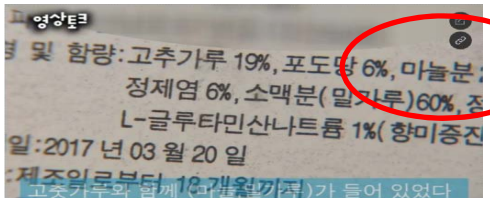


Authentic (left) Fraudulent (right)

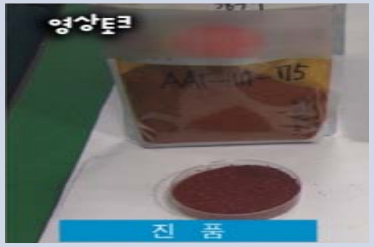
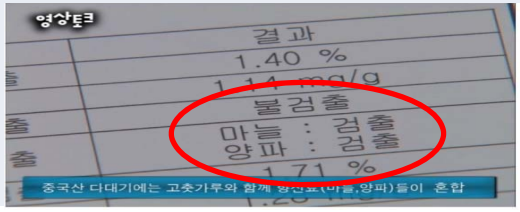


Scientific decision on fraudulent red pepper powder

Content of Mixed Seasoning!

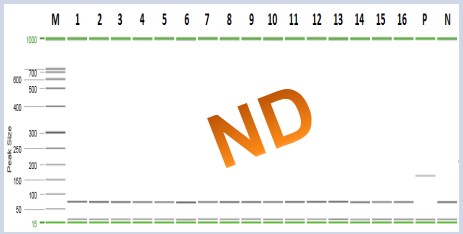
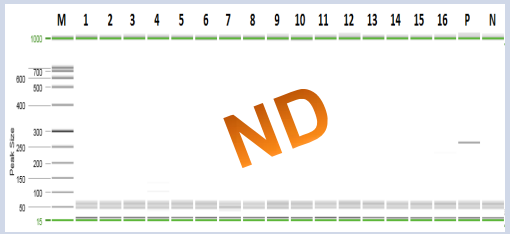
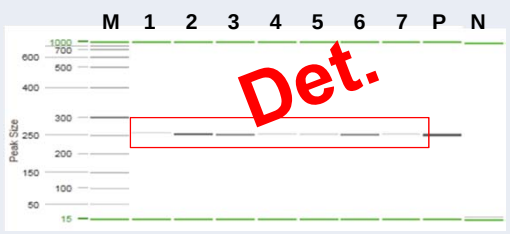


Garlic & Onion

Powder of Red Pepper	Content	Species-specific ID
Authentic 	Red pepper (100%)	Garlic Specific Gene: Negative Onion Specific Gene: Negative
Fraudulent 	Red pepper (19%), Garlic, Onion, Glucose, wheat flour, Salt, L-Glutamic acid, …	Garlic Specific Gene: Positive Onion Specific Gene: Positive 

Detection of foreign genes by species-specific PCR

Species	Scientific name	Genetic marker*	Sequence	Product size (bp)
Red Pepper	*Capsicum annuum*	CCS	F - CTA ATG GAA ACC CTT CTA AAG C R - GGT TGG ATT TGG AAA AGT GG	102
Garlic	*Allium sativum*	SSR	F - AAT CTC CCT CCA AAG TCC C R - CTG TAT TTT GTG TAA AGC ATC A	180
Onion	*Allium cepa*	SSR	F - GTT TCT TGG ATG CGA TTT TG R - GCA ACT GTA TAA TCA GCA TAT GC	280

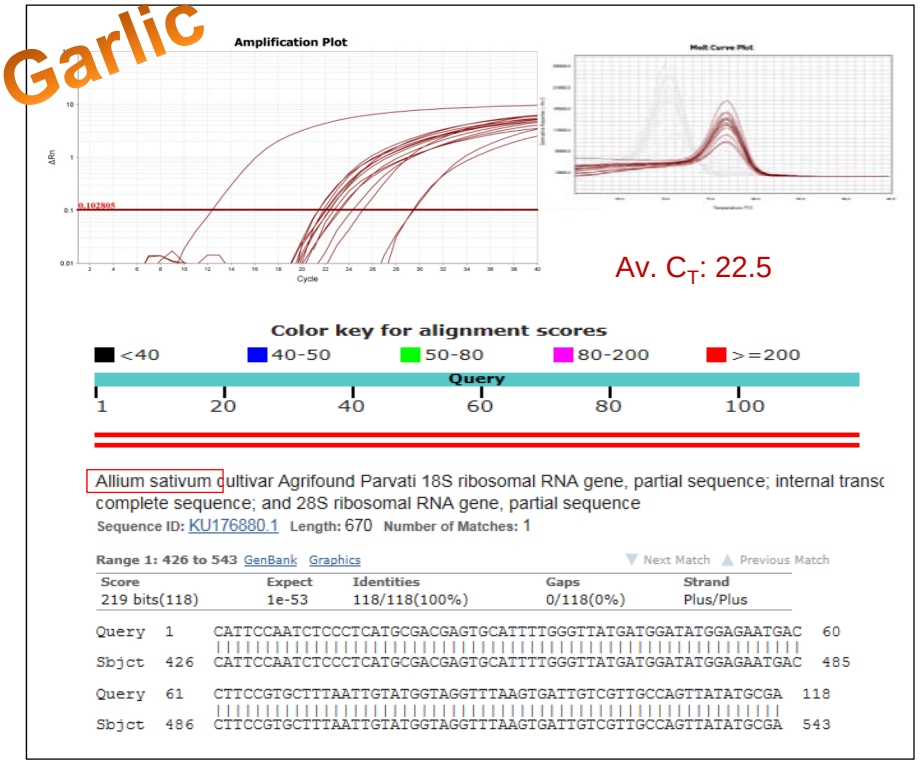
Red Pepper	Red Pepper	Garlic	Onion
Authentic (n=16)			
Fraudulent (n = 7)			

* CCS: Capsanthin – Capsorubin Synthase, SSR : Single Sequence Repeat

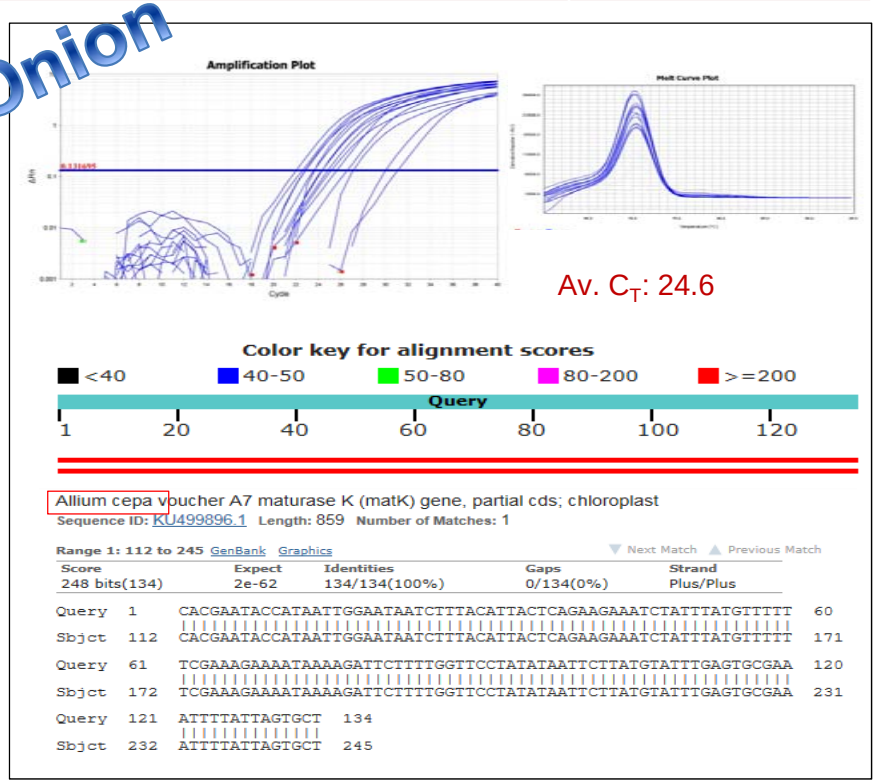
Confirmation

Species	Scientific name	Genetic marker	Sequences	Product size (bp)
Garlic	*Allium sativum*	ITS	F - CAT TCC AAT CTC CCT CAT GC R - TCG CAT ATA ACT GGC AAC GA	118
Onion	*Allium cepa*	matK	F - CAC GAA TAC CAT AAT TGG AAT AAT CTT TA R - GCA ACT GTA TAA TCA GCA TAT GC	134

Garlic



Onion



Arrest of counterfeiter of red pepper powder with mixed seasoning

8뉴스 사회

중국산 고추 양념이 '100% 국산 고춧가루'로...덜미 잡힌 일당

송인호 기자 songster@sbs.co.kr 작성 2017.07.08 20:32 수정 2017.07.08 22:06 조회 1,654 프린트 글자 크기 + −

<앵커>

값싼 중국산 고추 양념을 말려서 100% 국산 고춧가루로 둔갑시켜 팔아온 업자가 붙잡혔습니다. 고추 양념을 수입하면 고춧가루보다 관세가 싼 점을 노렸습니다.

01 Current State of outbreaks

02 Domestic outbreak cases

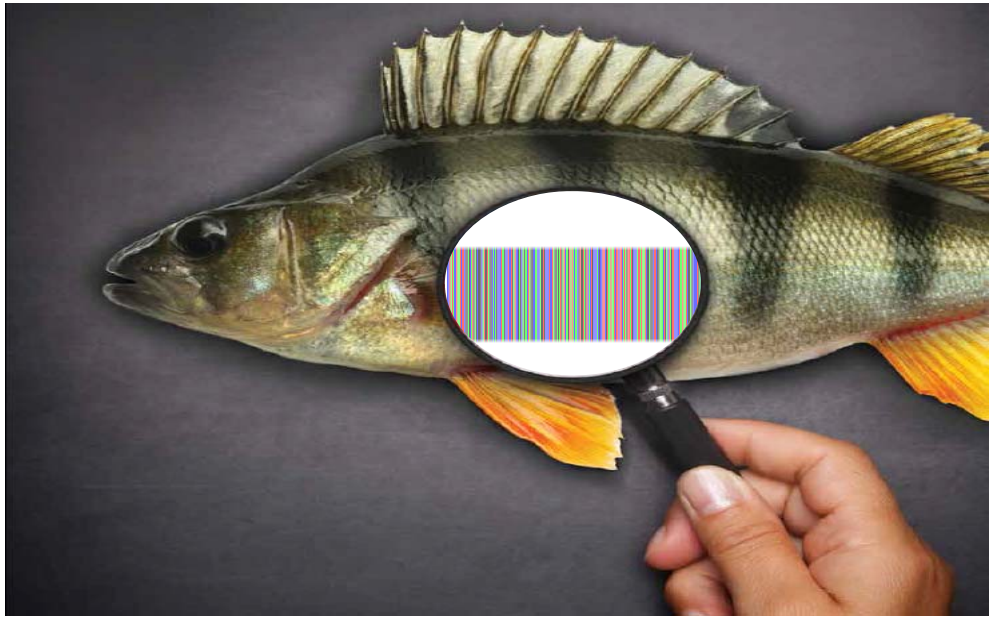
03 Efforts we have made

04 Future strategy

DNA Barcode?

‘New system of species identification using a short section of DNA from a standardized region (e.g. COI, *matK, rbcL*) of the genome’

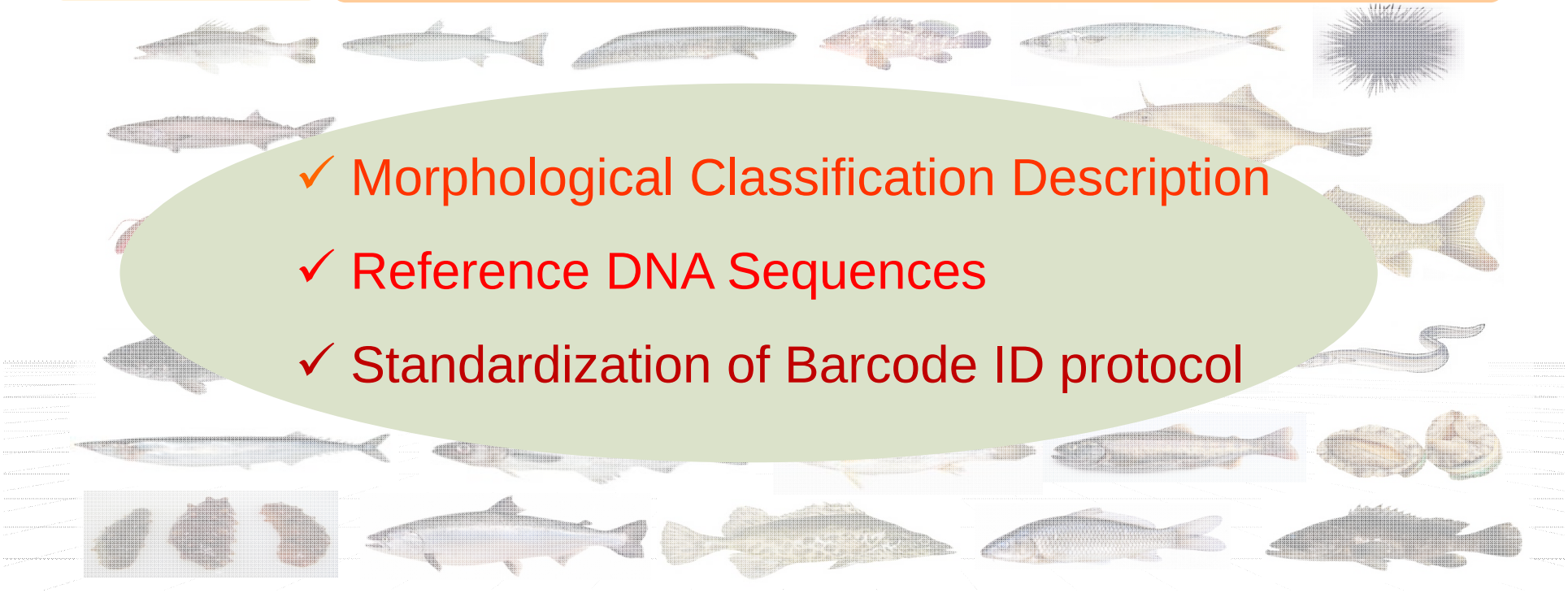
[Paul Hebert *et al.* Univ. of Guelph, 2003]



Prof. Paul D. N. Hebert,
Canadian biologist.
University of Guelph in Ontario, Canada

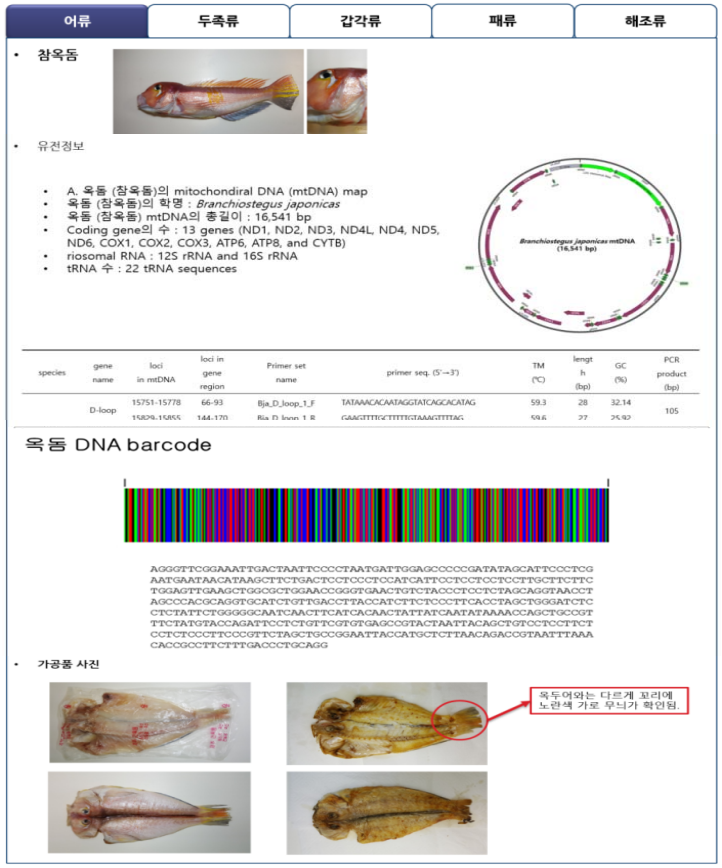
Future Plan

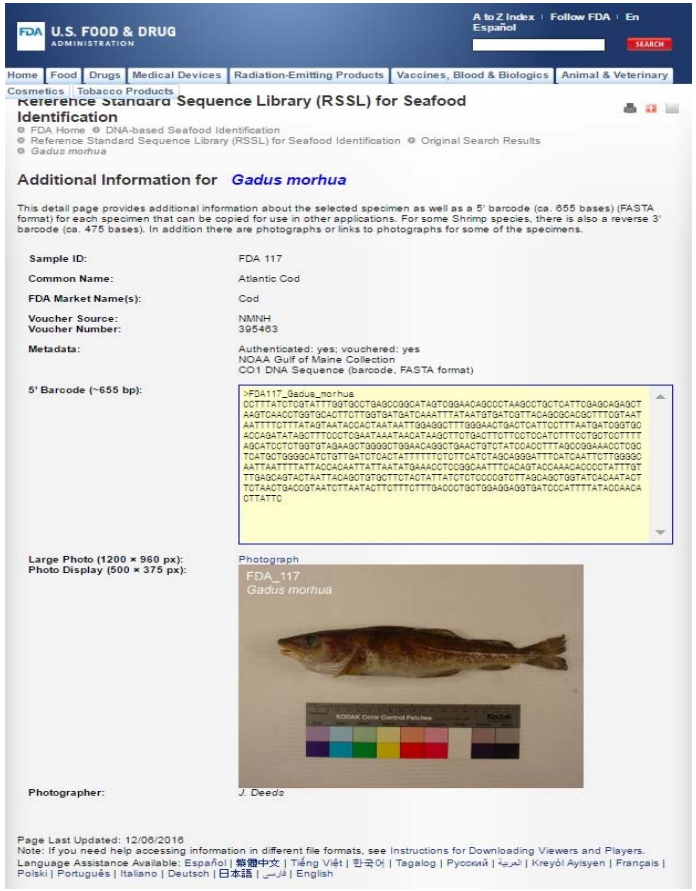
Project	Research on reference DNA sequences for seafood species Identification
Budget	$ 5.7 Million/ 5 yrs (‘17 ~ ‘21)
Objectives	Species identification based on DNA barcode sequence for commonly consumed seafood in Korea



- ✓ Morphological Classification Description
- ✓ Reference DNA Sequences
- ✓ Standardization of Barcode ID protocol

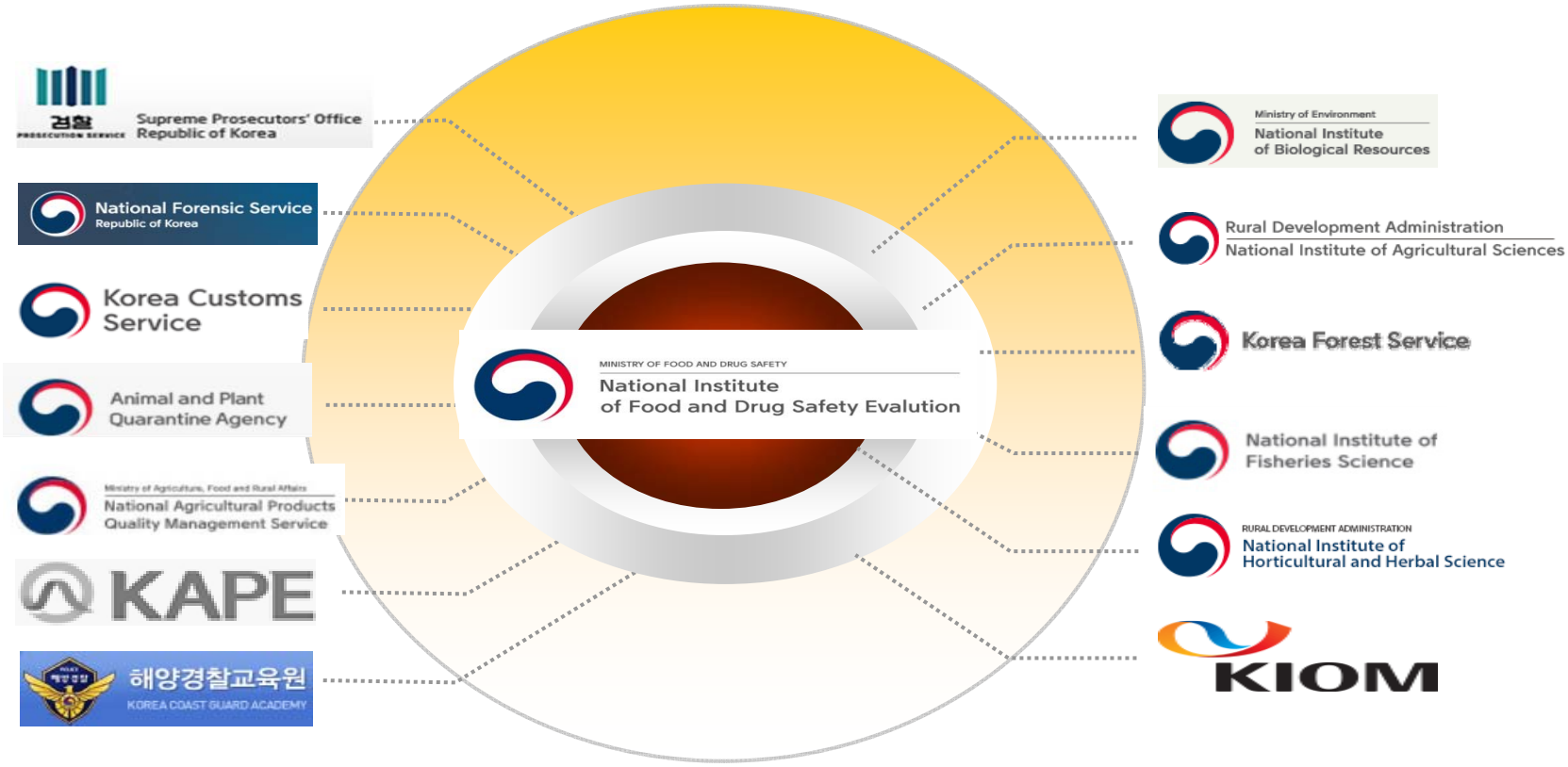
✓ Reference standard sequences for commonly consumed seafood ID





✓ Data sharing through ‘Consortium of Forensic Biology (since 2014)’

- 7 investigation agencies, 7 research institutes



Conclusion

- Increased interest in food fraud, now leading to global discussions

  - CCFICS (under Codex) now operates an electronic test work .

    *EMA (Economically Motivated Adulteration)

- The majority of the food adulteration cases in South Korea are material substitution

  - Intentionally manufacturing with substituted materials in order to gain economic profits.

    ex) Fresh-prepared sashimi, red pepper powder, fruit nectar, and meat

- The four characteristics of material substitution cases

  - A bigger difference in price, not possible to differentiate the materials with naked eyes, repeated occurrence, and materials that cannot be used for food products

- Development of DNA markers for food material authentication and scientific administrative support

  - Develop genetic identification methods for 230 animal/plant-based materials and apply them to fraud cases.

- Expand the research efforts for the technology to identify species using PCR and genetic barcodes

  - Initiate the barcode research projects for identifying related species for agricultural or fisher products.

Thank you!

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