Tilapia quality and safety in global markets

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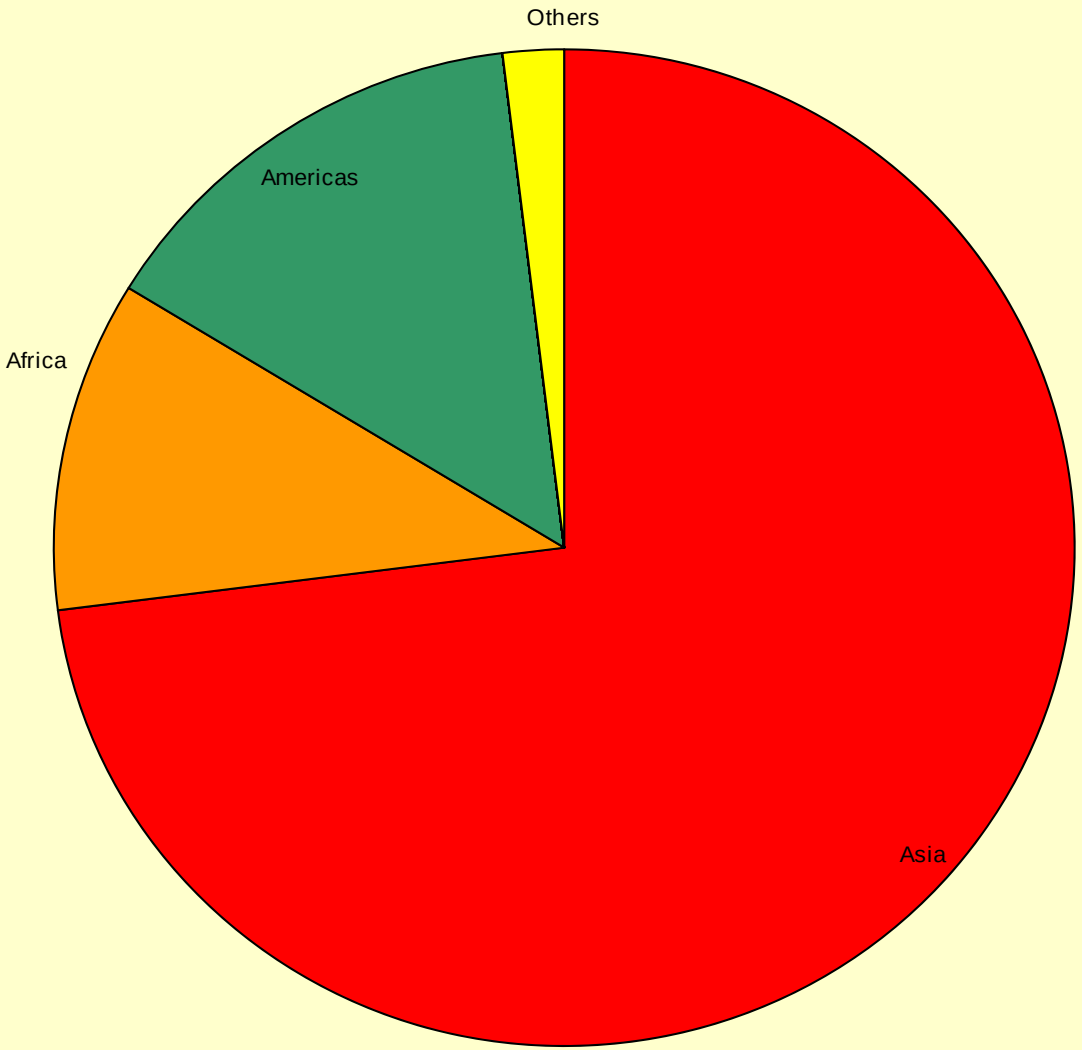
Overview

- Global perspective
- Problems with off-flavor
- Sex reverse hormones
- Antibiotics
- Carbon monoxide
- Quality control in processing
- HACCP, ISO and NGO certifications
- New products

Tilapia aquaculture

- Second most important farmed fish after the carps
- Most widely grown of any farmed fish
- Asian countries are major producers and consumers

World Tilapia Production of 2,381,237 mt in 2006



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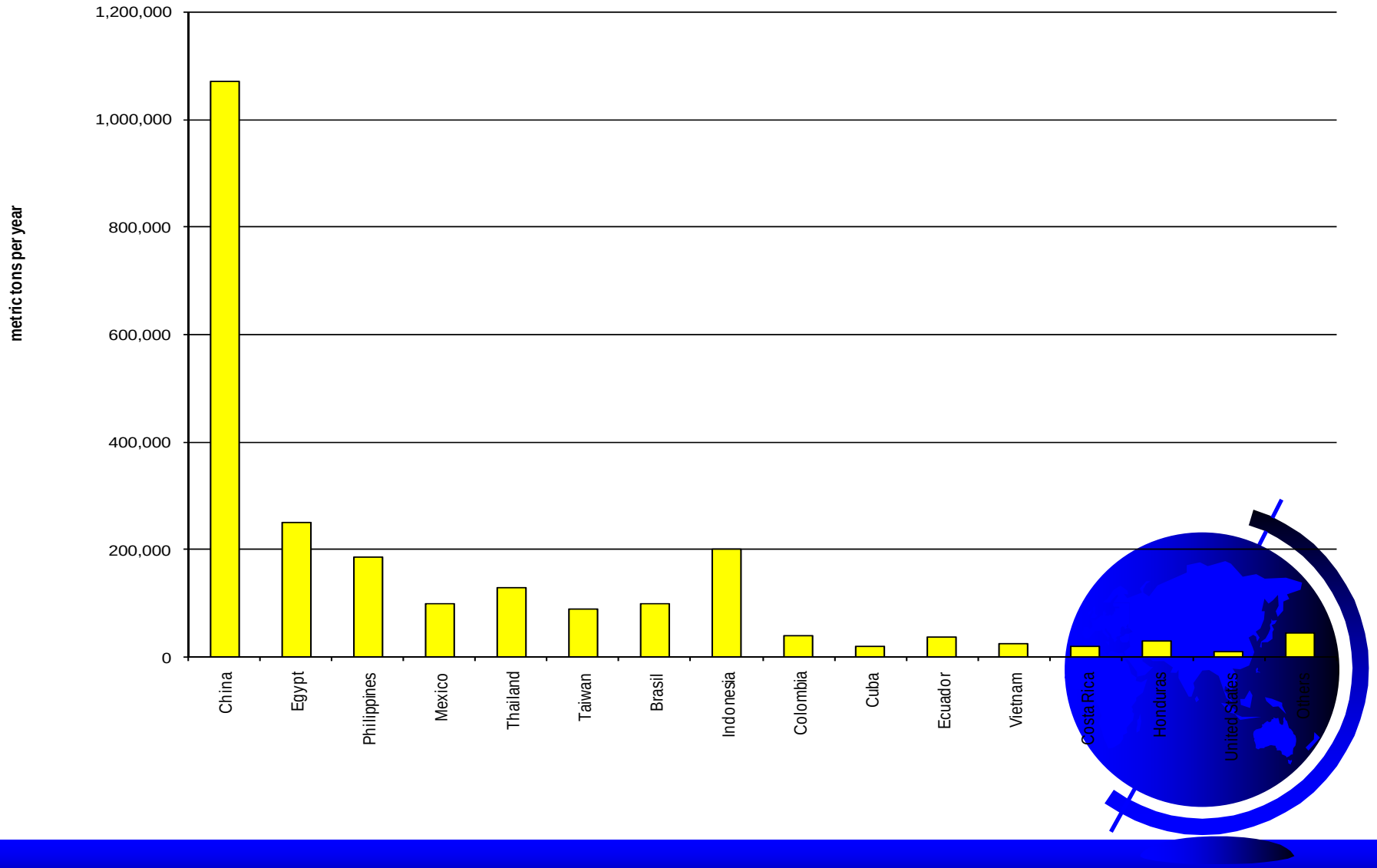
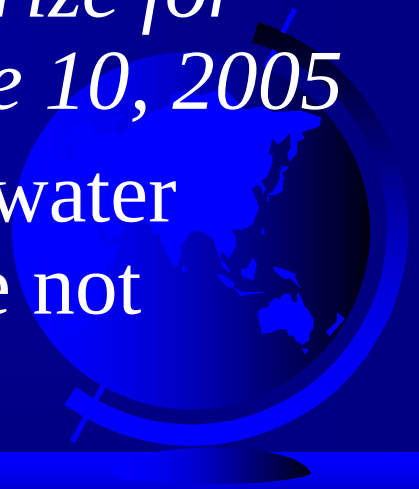
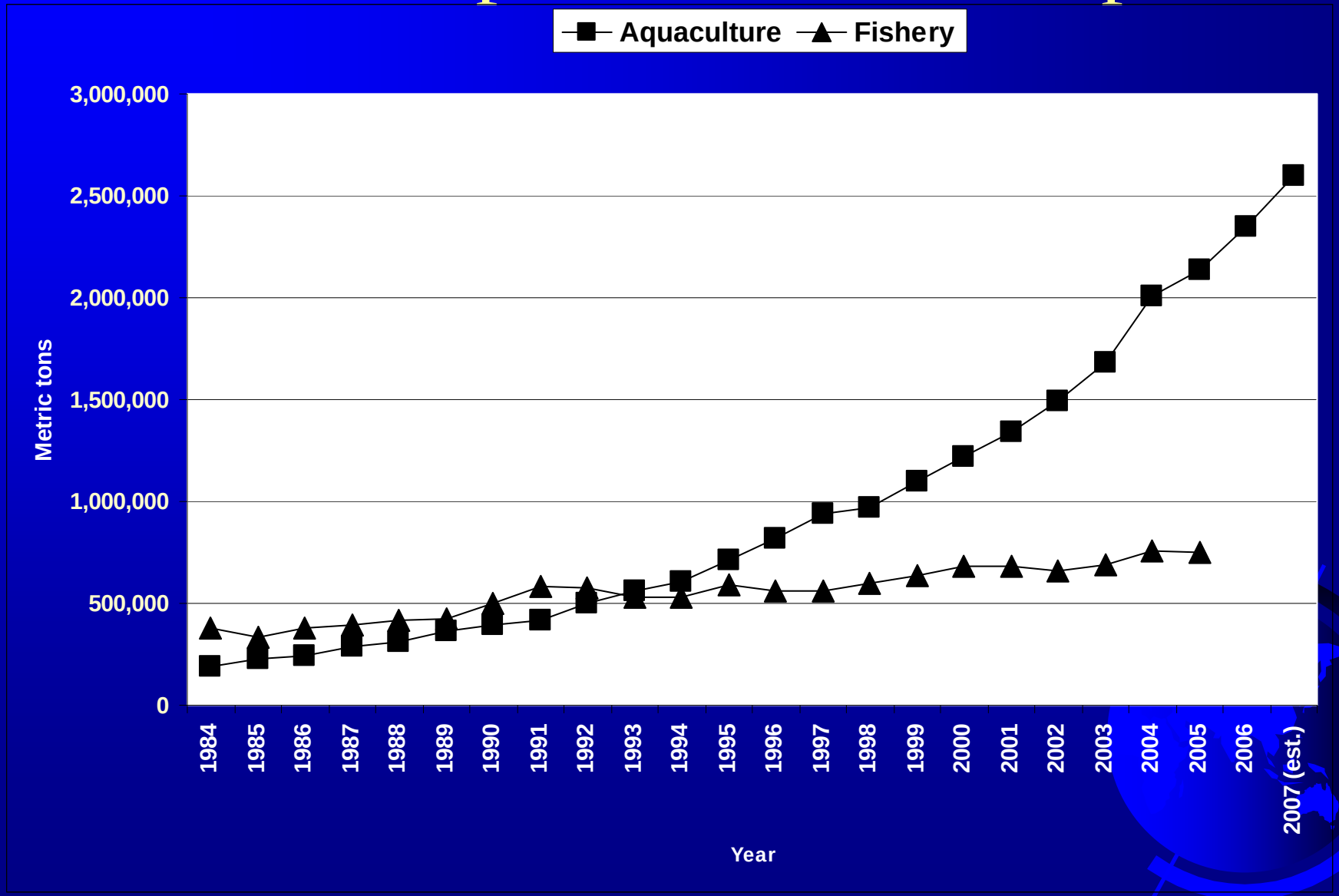


Tilapia the “Green” farmed fish

- Herbivore / omnivore, low trophic level feeder
- Algae, bacteria, and detritus (bioflocs) are important food sources
- Prepared feeds are mostly grains and ag by-products
- Promoted by aid agencies and NGO’s
- *Dr. M. Gupta awarded World Food Prize for promotion of tilapia aquaculture, June 10, 2005*
- Disease resistant and tolerant of poor water quality. Antibiotics and chemicals are not needed for commercial farming.



Global production of tilapia



Top Ten Seafoods (U.S.) per capita (lbs)

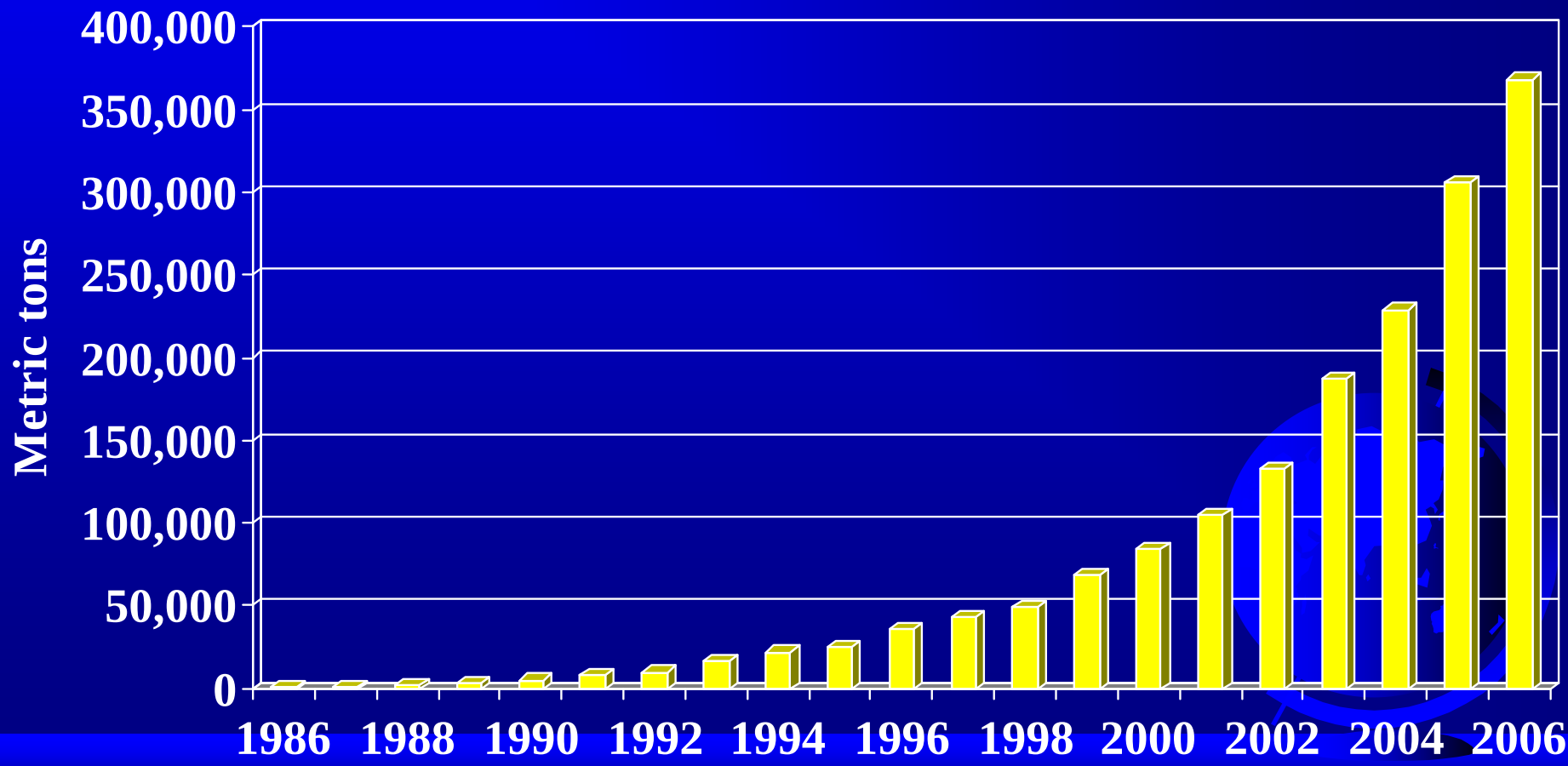
2000	2001	2002	2003	2004	2005	2006
Tuna 3.5	Shrimp 3.4	Shrimp 3.7	Shrimp 4.0	Shrimp 4.2	Shrimp 4.1	Shrimp 4.4
Shrimp 3.2	Tuna 2.9	Tuna 3.1	Tuna 3.4	Tuna 3.4	Tuna 3.1	Tuna 2.9
Pollock 1.6	Salmon 2.0	Salmon 2.0	Salmon 2.2	Salmon 2.2	Salmon 2.4	Salmon 2.0
Salmon 1.5	Pollock 1.2	Pollock 1.1	Pollock 1.7	Pollock 1.7	Pollock 1.5	Pollock 1.6
Catfish 1.1	Catfish 1.1	Catfish 1.1	Catfish 1.1	Catfish 1.1	Catfish 1.0	**Tilapia 1.0**
Cod 0.8	Cod 0.6	Cod 0.7	Cod 0.6	**Tilapia 0.7**	**Tilapia 0.8**	Catfish 0.97
Clams 0.5	Clams 0.5	Crabs 0.6	Crabs 0.6	Cod 0.6	Crabs 0.6	Crabs 0.66
Crabs 0.4	Crabs 0.4	Clams 0.5	**Tilapia 0.5**	Crabs 0.6	Cod 0.6	Cod 0.51
Flatfish 0.4	Flatfish 0.4	**Tilapia 0.4**	Clams 0.5	Clams 0.5	Clams 0.4	Clams 0.44
Scallops 0.3	**Tilapia 0.4**	Flatfish 0.3	Scallops 0.3	Scallops 0.3	Scallops 0.3	Scallops 0.31
Tilapia 0.3						

US Tilapia consumption (imports and domestic)

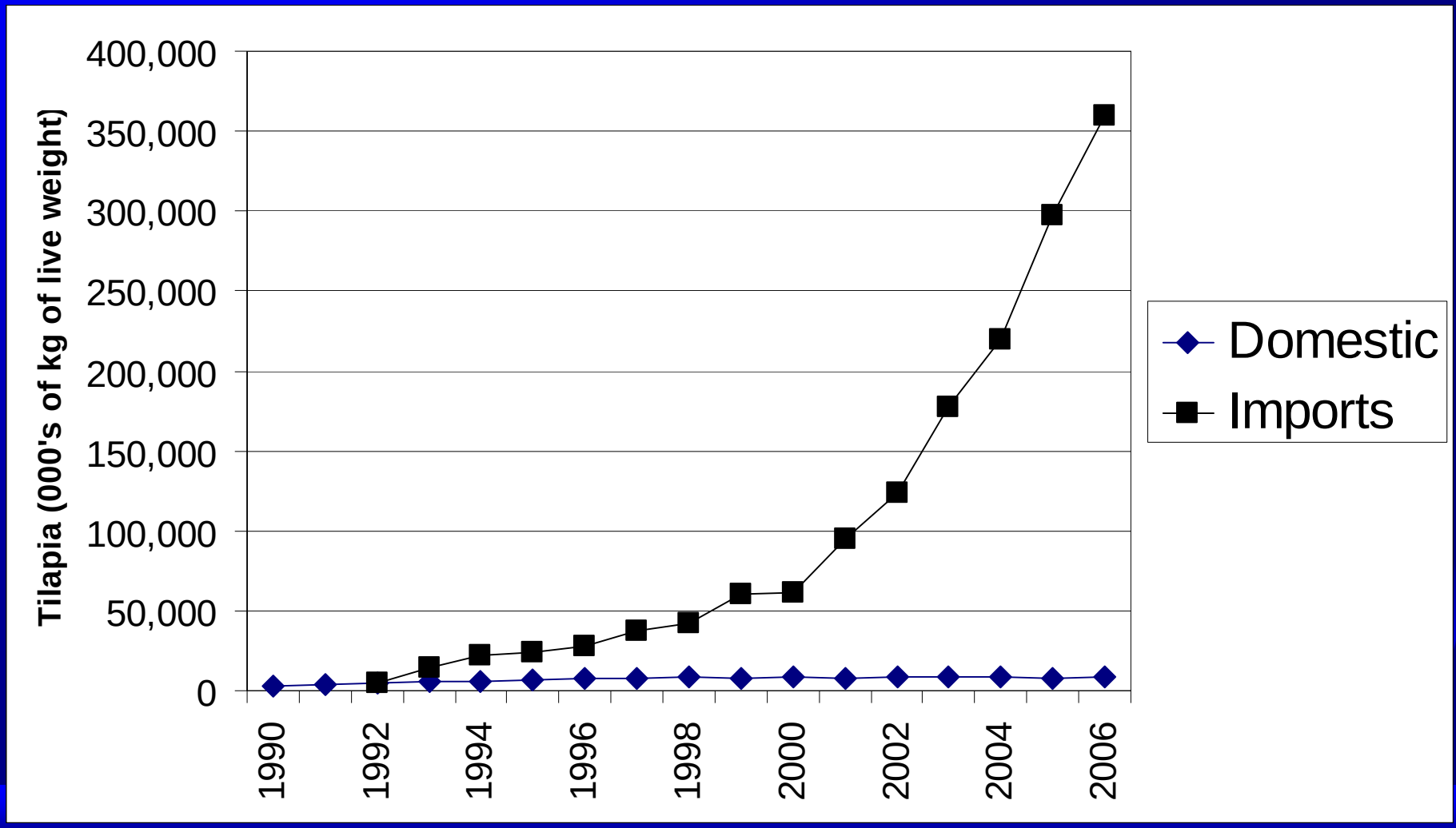
229,000 mt of live weight (equivalent) - 2004

306,410 mt of live weight (equivalent) – 2005

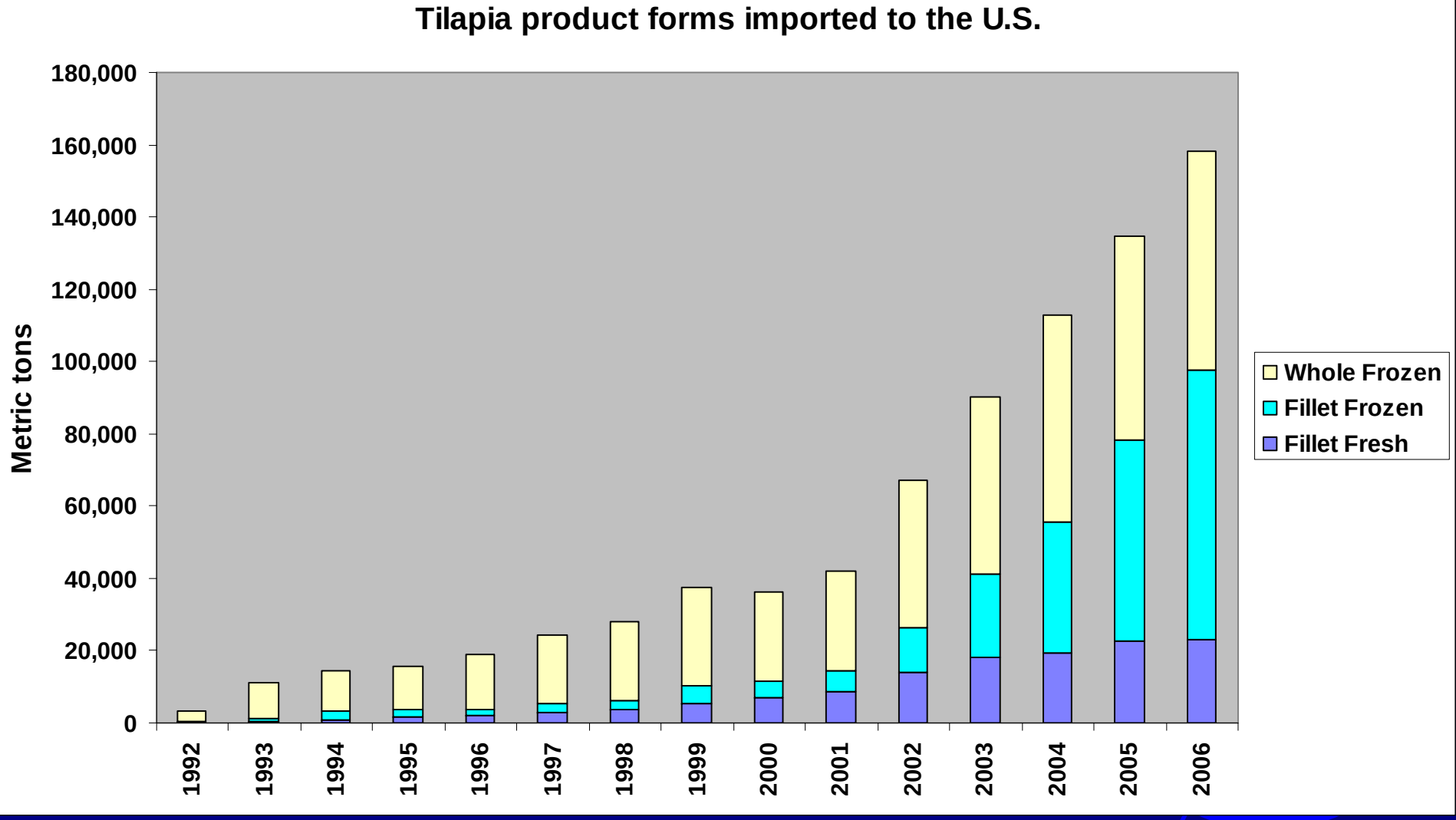
368,295 mt of live weight (equivalent) – 2006



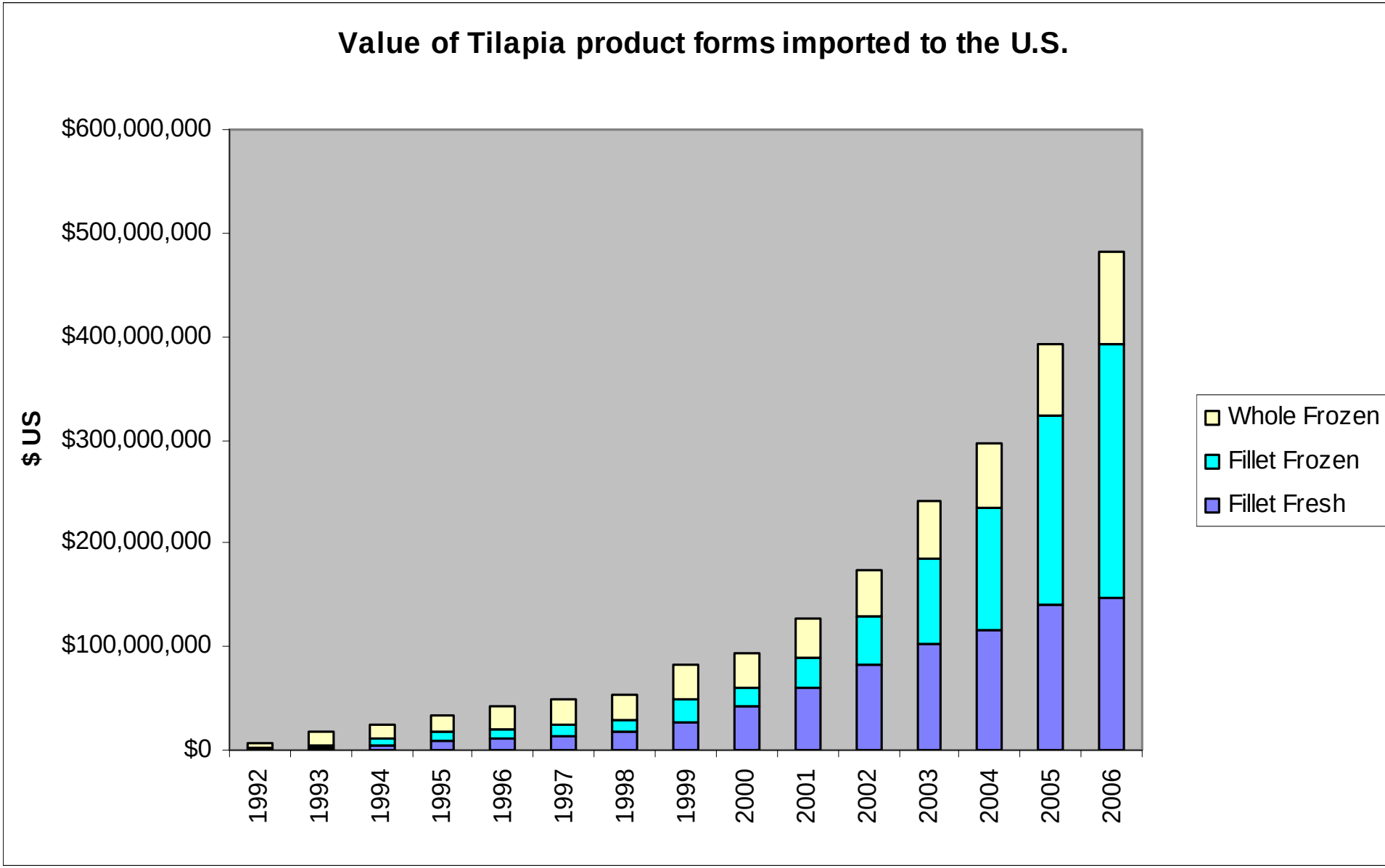
US Consumption of tilapia from domestic and imported sources



23,101 mt fresh fillets, 74,381 mt frozen fillets, 60,772 mt whole frozen (2006)



$241,205,610 (2003) $297,413,000 (2004) $392,978,298 (2005) $482,742,515 (2006)



Tilapia (May 25, 2005 Madrid Daily)

- Europe is following US trend of adopting tilapia as replacement for traditional fishes

MIÉRCOLES 25
MAYO DE 2005

LA VIDA | Qué! 25

ESPAÑA INVESTIGA LAS CUALIDADES DE ESTE PEZ LLENO DE VENTAJAS

Tilapia, el pescado que comeremos el año que viene

N. ESCRIBANO

UN DESCONOCIDO MUY SANO

La tilapia es un pez aún desconocido en Europa, pero en un año podría llegar a sustituir al pescado de carne blanca (trucha, mero, lubina). Varios países europeos (Francia, Bélgica...) están investigando con él; en Madrid lo hace el profesor Morris Villarroel de la Escuela Técnica Superior de Ingenieros Agrónomos de la Politécnica. Sus ventajas son: logra pasar de cien gramos a medio kilo en seis meses (la trucha tarda un año), es omnívoro y se reproduce bien. Ya está en algunos mercados.

Podría sustituir a la trucha y el atún

La alimentación de la tilapia es barata, ya que es un pez omnívoro. Se le puede dar de comer soja; lo que, además, puede reducir la contaminación del agua donde se crían. Tener un precio similar a la dorada, junto a su rapidez de crecimiento, es otra de las bazas con las que cuenta este pescado para sustituir a otros presentes en el mercado actual.

Las empresarios aún no se arriesgan en Europa

En Europa aún se está investigando la producción de este pescado. En España se han lanzado algunos empresarios en Valencia y Córdoba.

En EEUU se conoce como el pescado sano

La tilapia se produce en grandes cantidades en Estados Unidos y Canadá, aunque en estos países no venden el pescado entero, sino fileteado. Allí "la tilapia es considerada por el consumidor como un pez sano", afirma Morris Villarroel. Ese es uno de los motivos por los que se vende muy bien. En Sudamérica, África y Asia también se cría, lugares donde suele ser más barato.

Tiene una textura parecida a la dorada y no tiene casi grasa

La textura de la tilapia "recuerda a la de la dorada, aunque es algo más compacta", afirma el profesor Villarroel. Además, este pez tropical no tiene sólo fama de sano, sino que lo es: junto a todos los aminoácidos esenciales, sólo tiene un 1% de grasa, mientras el atún tiene más del 10%. De momento, la tilapia sólo tiene una pega: no es un pez tan atractivo como otros visualmente por lo que se vende más en filetes.

Tilapia (June 2007, Tesco, UK)

$18 US per kg whole fish!!!!

Off-flavor

- Off-flavor due to geosmin and MIB
- Many farms in Asia and Latin America utilize green water production systems
- Frequently have cyanobacterial blooms
- Testing for off-flavor before harvest, on arrival to processor, during processing

Depuration systems

- Reduce feeding for several days in production unit and increase water flow
- Dedicated depuration system (tanks or raceways). Clean water for two or three days sufficient for majority removal of off-flavor compounds

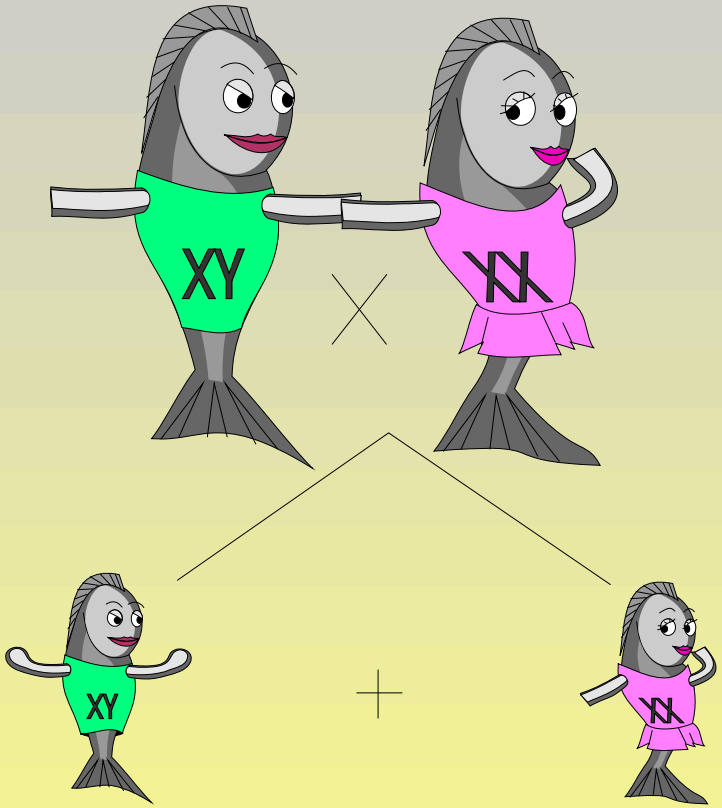
Hormones for sex reversal

- Methyltestosterone used for sex-reversal during first 21 days of feeding
- Dosage of 60mg/kg of feed
- Non- detectable level 90 days after cessation of sex-reverse diet, harvest still 4 -6 months later
- US-FDA INAD, approved for use during application process
- In developing countries concern for female workers handling the hormone while making feed

The YY male technology

- Combines hormonal feminization of male fry, XY females are crossed to normal (XY) males producing ¼ XX and ½ XY and ¼ YY
- Use progeny testing to determine YY males
- YY males sire only male (XY) progeny from crosses with normal (XX) females
- All male progeny (actually ≥ 95% male) are known as genetically male tilapia (GMT®)

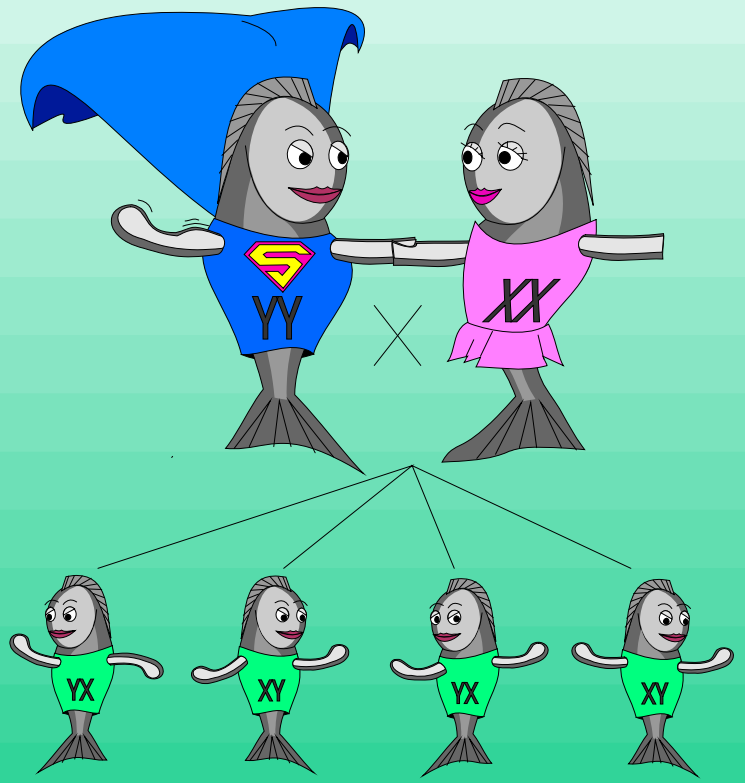
The YY male technology



Normal crosses produce equal proportion of males and females

THEN

NOW



YY males produce only male progeny (GMT®)

Use of antibiotics and resistance

- Streptococcus is primary bacterial pathogen in tilapia culture. Mostly in intensive, especially recirculating, production systems
- Vibrio bacteria have also been reported from marine and brackish water cultures
- Medicated feeds have been used commercially
- Some antibiotic resistance reported in Brazil

Reducing antibiotic use

- Several vaccines have been developed for Strep
- Farmers in many countries have been warned against using antibiotics in tilapia aquaculture
- Reduced densities and improved water quality invariably ameliorate the problem

Imports are mostly fresh and frozen fillets

- Proccesing and hand trimming of fillets

- Buyers are requesting fresh or fresh appearance even in frozen product

Many fillets are treated with carbon monoxide

(CO, also called liquid smoke)

- CO infuses into fillet and reacts with myoglobin
- Fillet maintains fresh appearance for longer period
- Little health risk, beyond disguising spoilage

- First method was to fill bags with CO and fillets for 10 minutes before freezing

Carbon monoxide - CO

- Especially common at Chinese processors
- Initially CO infusion in bags, then moved to cabinets, now retort vessels

Carbon monoxide (CO)

- Rapidly improving the technique, and providing safety to workers
- Must be labeled as an additive in US and EU

Parasites

- Tilapia sometimes get heavy infestations of external parasites, which can affect growth rates. Very rare to get any internal parasites or serve as host for any human parasites
- Reports of fish contaminated with malachite green or methylene blue used to treat external parasites

Pollutants and Contamination

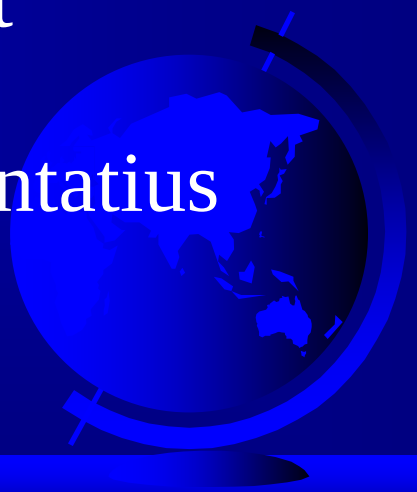
- In Peru and India, tilapia have been reared in effluent from sewage treatment plants
- Tilapia can survive in very poor quality (polluted) water. (Sewage and industrial)
- No reports of contamination, but should be checked

Demands on farmers and processors

- Demands for more food safety, high quality, "organic" or "green" tilapia products.
  - No off-flavor
  - Reduce or eliminate use of methyltestosterone hormone.
  - No antibiotics, malachite green or other chemicals
  - Reduce or eliminate use of CO
- Improved proccesing quality
- More value-added tilapia products
- More demand for all forms, especially frozen meals
- Rapidly increasing demand from Europe

ISO 9100 and ISO 22000

- ISO 9100 provides for certification of Hazard Analysis at Critical Control Points
- Covers product safety, plant and food hygiene, economic integrity, and product quality.
- ISO 22000, food safety management system, applies to all kinds of food processors linked to CODEX Alimentatius



HACCP

- Hazard Analysis at Critical Control Points
- Planning procedure for documenting good production and processing practices
- Participants operate under approved plan with audits at random frequency
- Focus is on documentation of proper activities at important stages rather than stationing a permanent inspector at farm or processing plant.
- Greater focus on critical processing steps.
- More cost effective

HACCP

- Examples:
- Document feed source and use, farm water quality, testing for off-flavor
- Document source, arrival time, temperature and condition of fish as they arrive at process plant
- Provide footbaths, hand washes and protective clothing for processing workers, document usage by having employees sign daily log
- Measure and record bacterial numbers on fillets during quality control

NGO certifications

- NaturLand
- World Wildlife Fund
- Aquaculture Certification Council

- Each reviewing sustainability of aquaculture practices and providing a certification and marketing logo

Improved quality control: Required for US, EU, and Japan markets

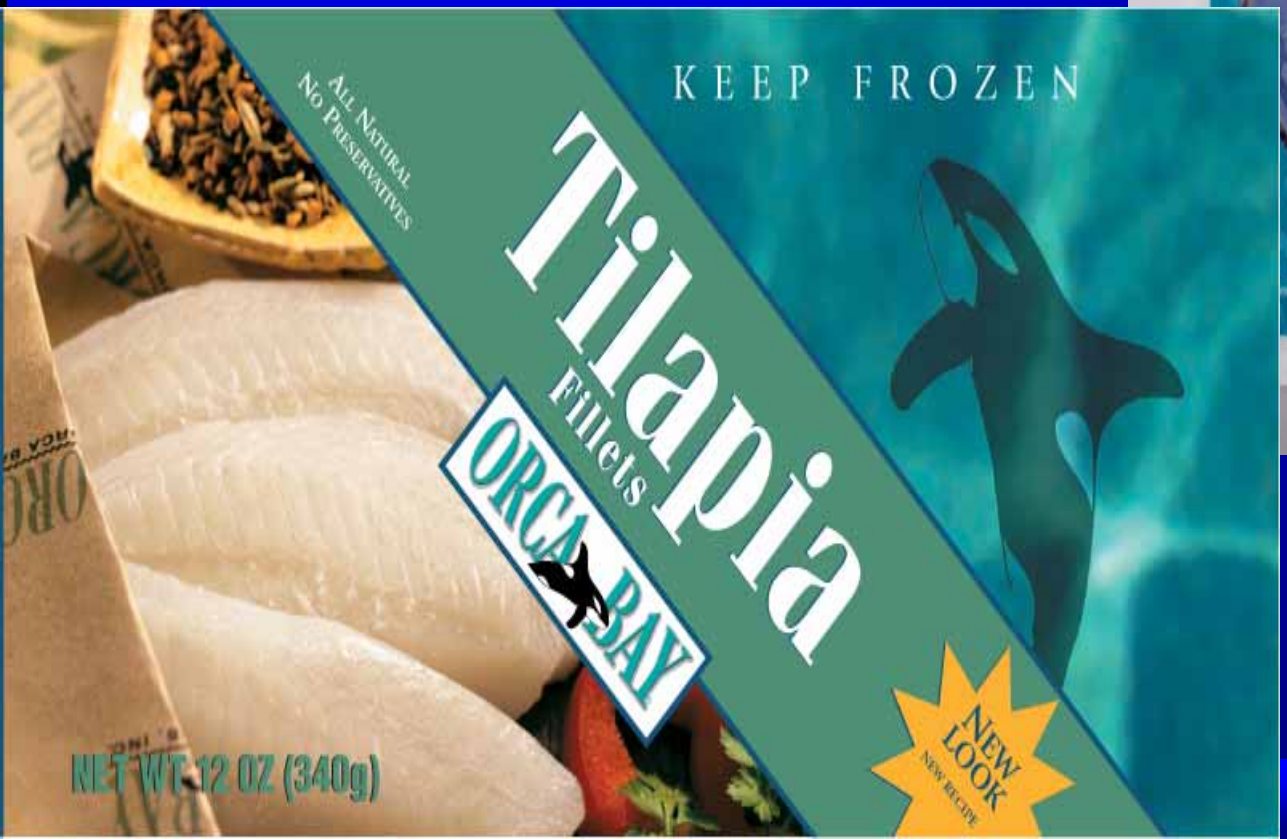
- Samples checked for bacterial and chemical contamination
- Follow HACCP procedures and EU guidelines
- Many plants are using ozone dips to reduce surface bacteria

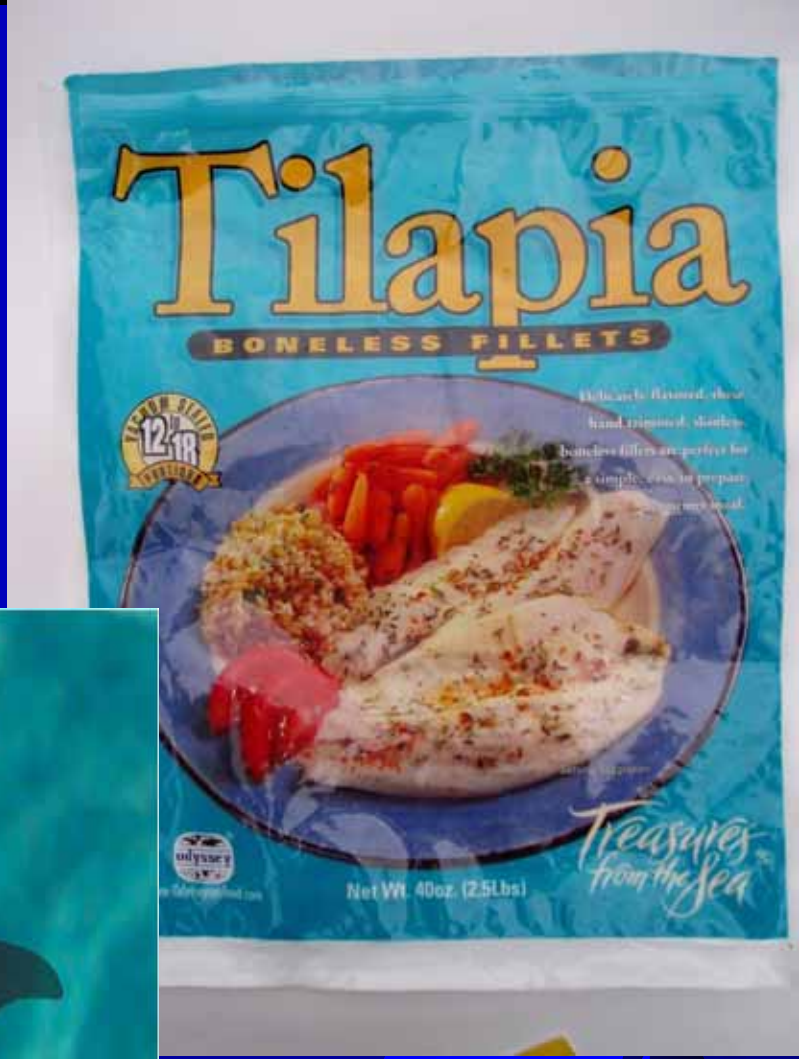
Why did tilapia avoid the import alert placed on Chinese farmed seafoods???

- Hardy fish that rarely need antibiotics or chemicals
- Proactive training of farmers and processors
- Importers demanding “clean” product
- Consumers expecting “green” fish

Improvements in packaging

IQF Fillets in re-sealable packages






Ocean
Tilapia
Fillets
Tropische zoetwatervis
Poisson d'eau douce tropical
Tropical freshwater fish
Tropischer Süßwasserfisch
Tropisk ferskvannsfisk
Tropisk sötvattensfisk


ANOVA
Gourmet
Tilapia
2


Tilapia
Tilapia
7-9


Tilapiafilet
gram (min. 4 stuks)
Verse vis uit Indonesië

RESEALABLE

High Liner

MILD TASTING

Tilapia Loins

Lean-cut,
individually vacuum packed

MICROWAVEABLE

- NO Additives
- NO Preservatives
- NO Carbohydrates

NET WT. 40 oz (2.5 lb.) 1.13 kg


FARM RAISED
TILAPIA
ALL NATURAL


Sea Cuisine
COCONUT CRUSTED TILAPIA
with Mango & Papaya
Nutrition Facts
SEA CUISINE TILAPIA COCONUT CRUSTED
SAFEWAY
$4.87
$1.22
$3.65


Sea Cuisine
TORTILLA CRUSTED TILAPIA
with Chipotle & Lime
Nutrition Facts
SAFEWAY
$5.91
Try Our Rancher's Reserve Beef
Guaranteed Tender


Ready to cook gourmet seafood
Sea Cuisine™
Natural Cut Crusted Fillets
TORTILLA CRUSTED TILAPIA
with Chipotle & Lime
NET WT. 2 LB (907g)
KEEP FROZEN
SERVING SUGGESTION


TRUSTED SINCE 1849
GORTON'S
NEW!
Premium Fillets
Tilapia
CRUNCHY BREADED FISH FILLETS
GORTON'S FIVE STAR TILAPIA
KEEP FROZEN
NET WT 17.2 OZ (488 g)


Oven Poppers
From Our Kitchens To Your Home
Tilapia
Stuffed with Sun Dried Tomato, Shrimp & Lobster
Carbs 8g
Protein 19g
2
Premium Choice
NET WT. 10 OZ. (284g) • KEEP FROZEN • LESS THAN 200 CALORIES PER SERVING


High Liner
SEAFOOD SELECTS
PRIMAVERA
TILAPIA
Tilapia and spring vegetables in a garlic butter sauce
ALL NATURAL INGREDIENTS
NET WT 32 oz (2 lbs) 907 g

Tilapia Orange Juice

Conclusions

- Concerns for off-flavor
- Some customers will not accept hormone treated . Could be a safety issue for hatchery workers
- Minimal use of antibiotics, and vaccines should further reduce that
- Carbon monoxide is the most controversial quality issue

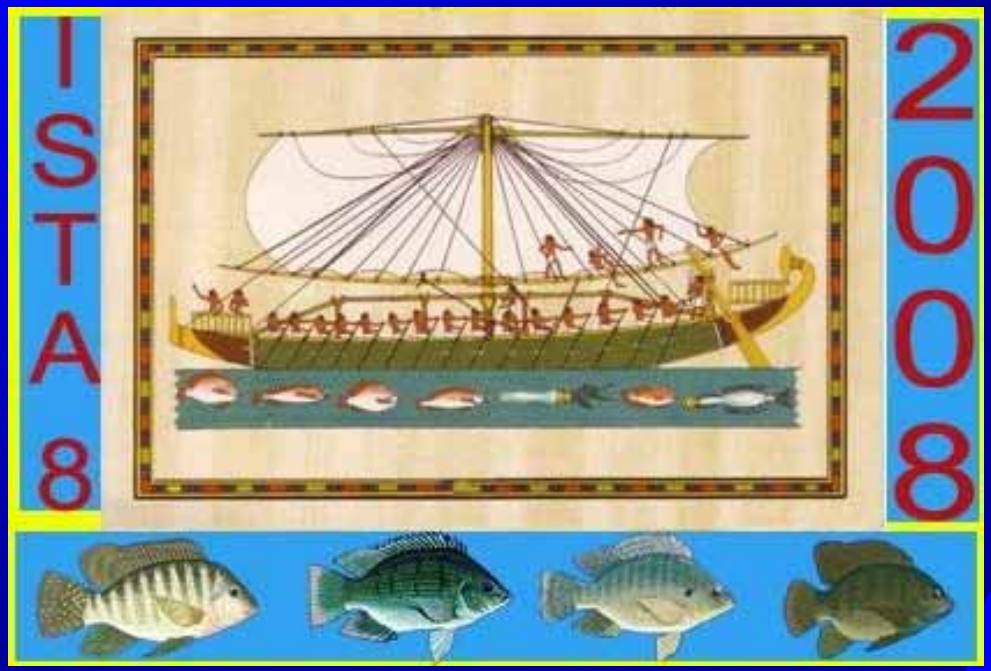
Conclusions

- ISO and HACCP and NGO certifications
- More demands for food safety, quality assurance, improved packaging, and environmental safeguards (with little if any increase in price)
- Farmers and processors will need to meet these demands by increasing efficiency, not price

Eighth International Symposium on Tilapia in Aquaculture

12-14 October, 2008

Cairo International Conference Center



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Collaborative Research
Support Program

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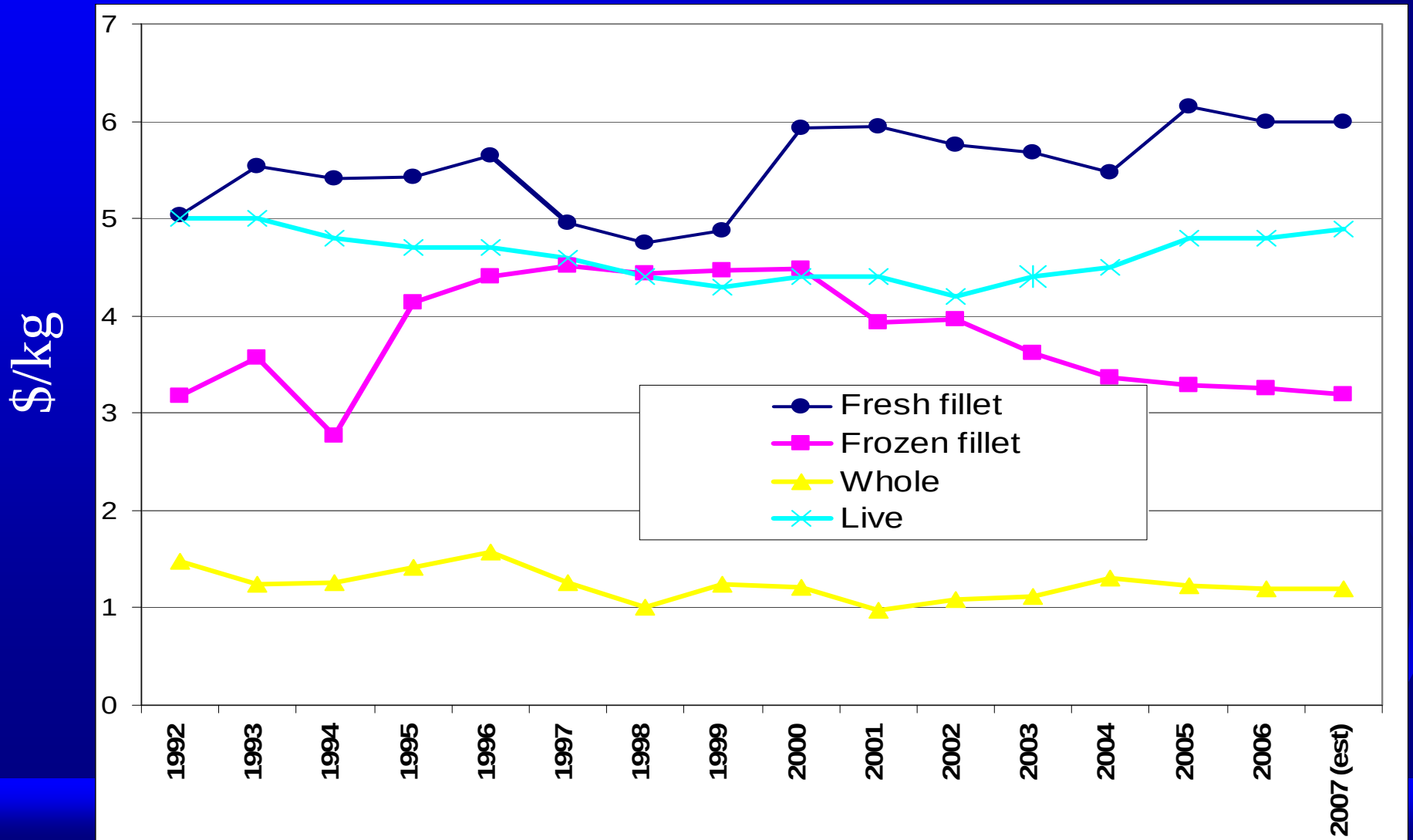
CENTER

WORLD
AQUACULTURE
SOCIETY

Global Tilapia Market Trends

Prices have been constant, only fresh fillets have increased slightly, will not see increases with inflation



Current Global Market Trends

- Increase in demand for all forms of tilapia
- Demand increase will be greatest for frozen fillets
- Demand increase will be significant for fresh fillets
- High profit margin for prepared meals assembled and packaged in developing countries

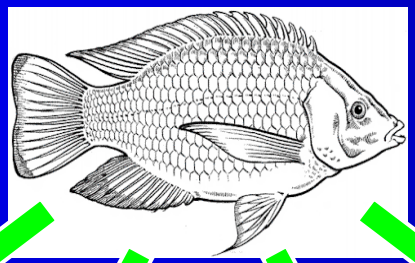
Global Aquaculture Tilapia Sales

- For year 2000 =US $ 1,744,045000
  (FAO FishStat 2007)
- 2005 sales = $ 2,457,312,000
  (FAO FishStat 2007)
- 2010 sales >$ 5,000,000,000

Tilapia Leather

Flowers made from Tilapia scales

Pathways in the use of tilapia as biomanipulator in shrimp farms



Promotion of *Chlorella* dominance

Feeding on organic waste

Bioturbation of sediment

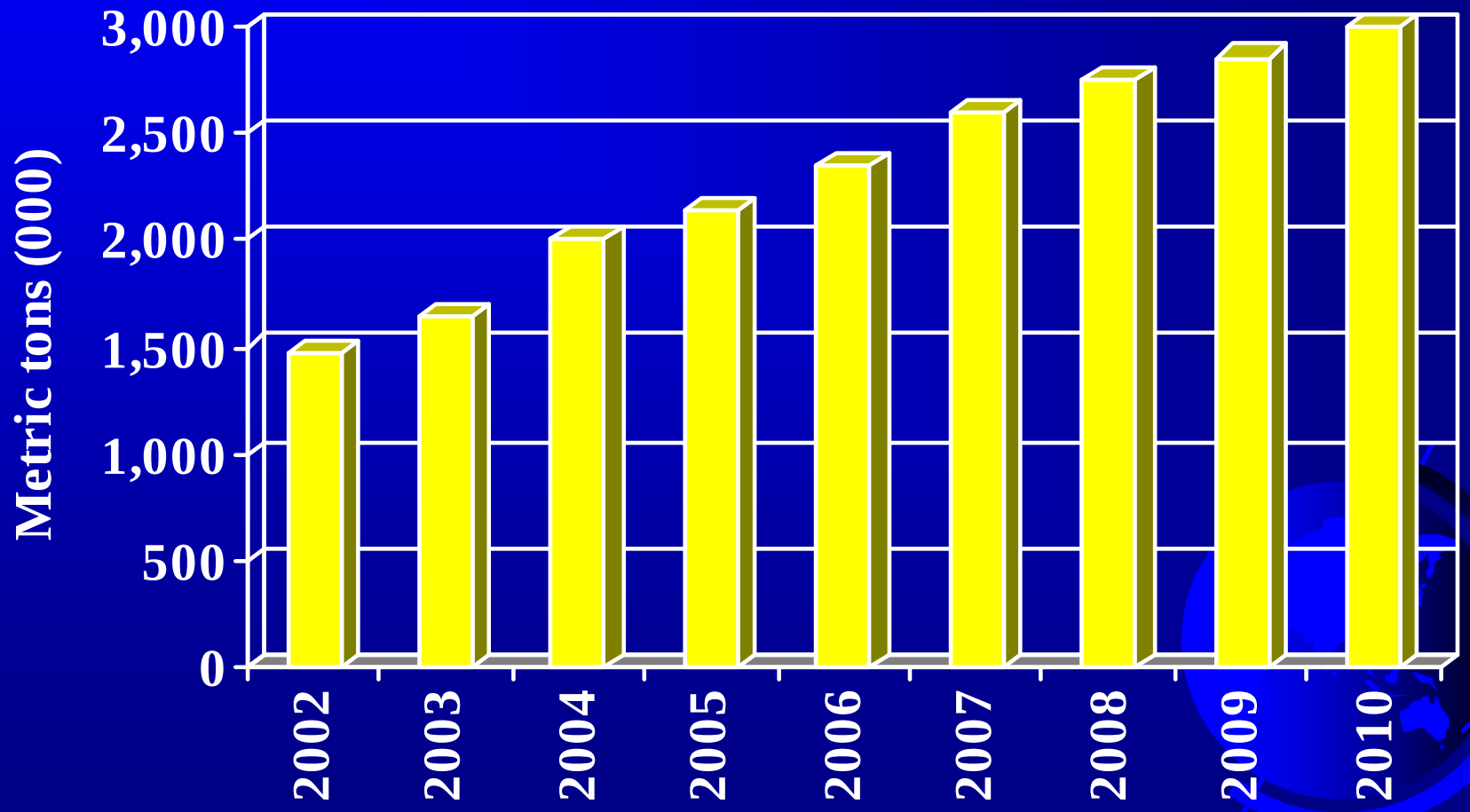
Production of natural antimicrobials

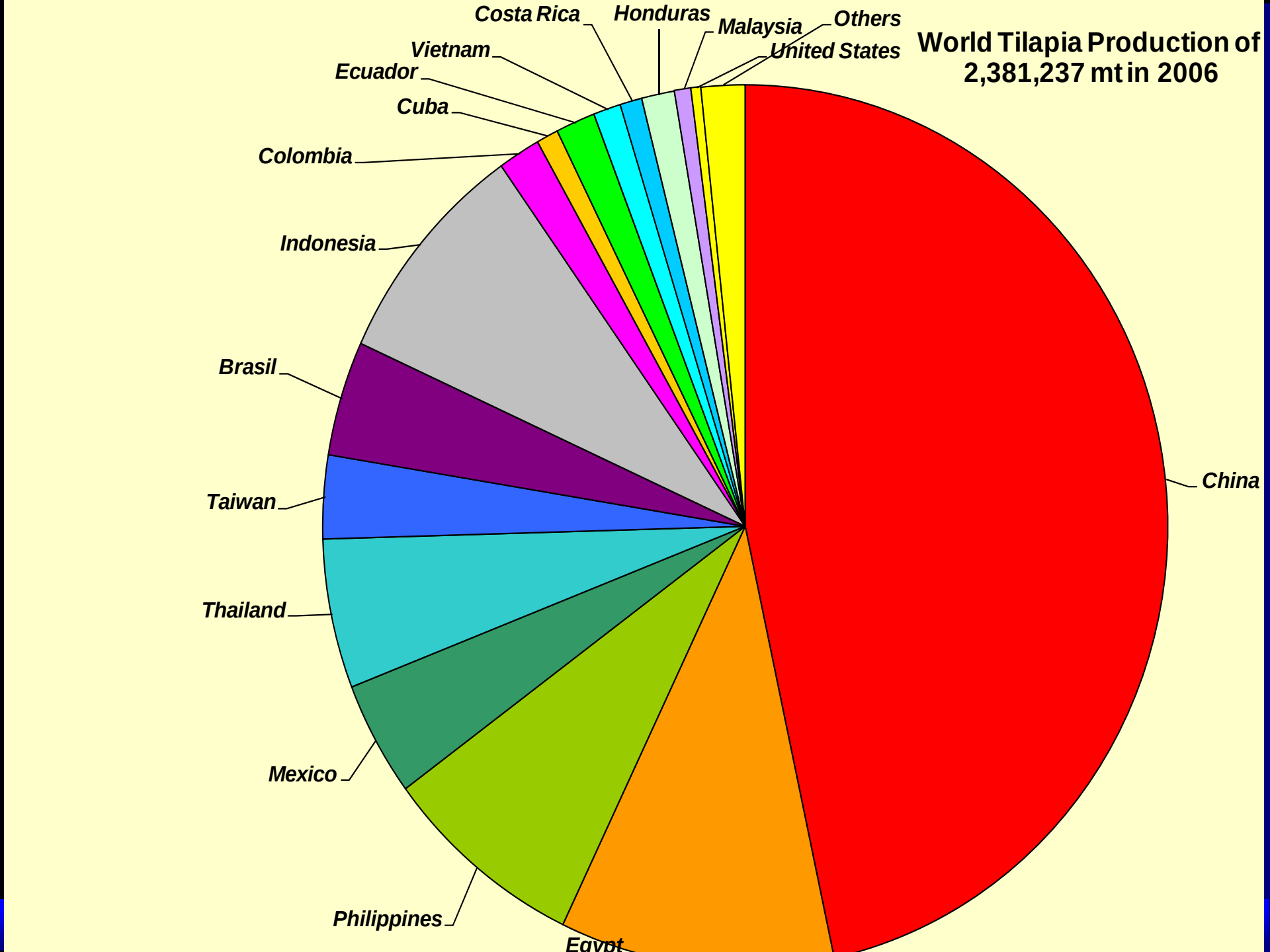
IMPROVED SEDIMENT QUALITY

IMPROVED WATER QUALITY

SUPRESSION OF GROWTH OF *V. harveyi*

Future global tilapia aquaculture

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Vietnam
Costa Rica
Honduras
Malaysia
United States
Others