

AGRILINKS



Building A Safe Food System: The Role of Cold Chain Logistics in Food Safety of Perishable Food

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Dr. Lourdes Martinez Romero is an agricultural economist in the Bureau for Resilience and Food Security, Food Safety Division. She specializes in market and food system development. Currently, Dr. Martinez Romero works on low-income consumers and micro, small and medium enterprises access to safe, nutritious food systems in local and international markets.

Building A Safe Food System: The Role of Cold Chain Logistics in Food Safety of Perishable Food





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Food Safety and Nutrition within a Food System



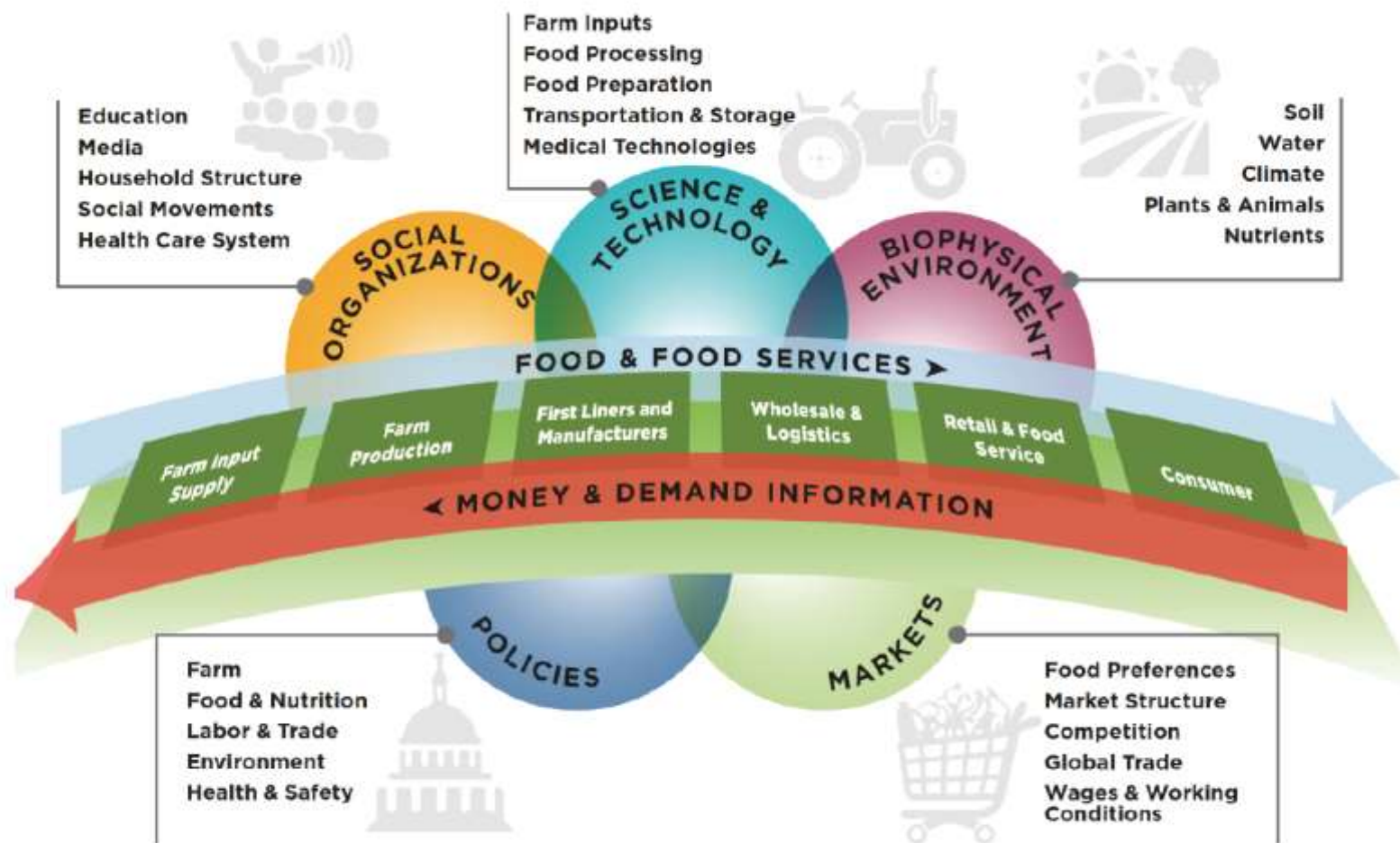
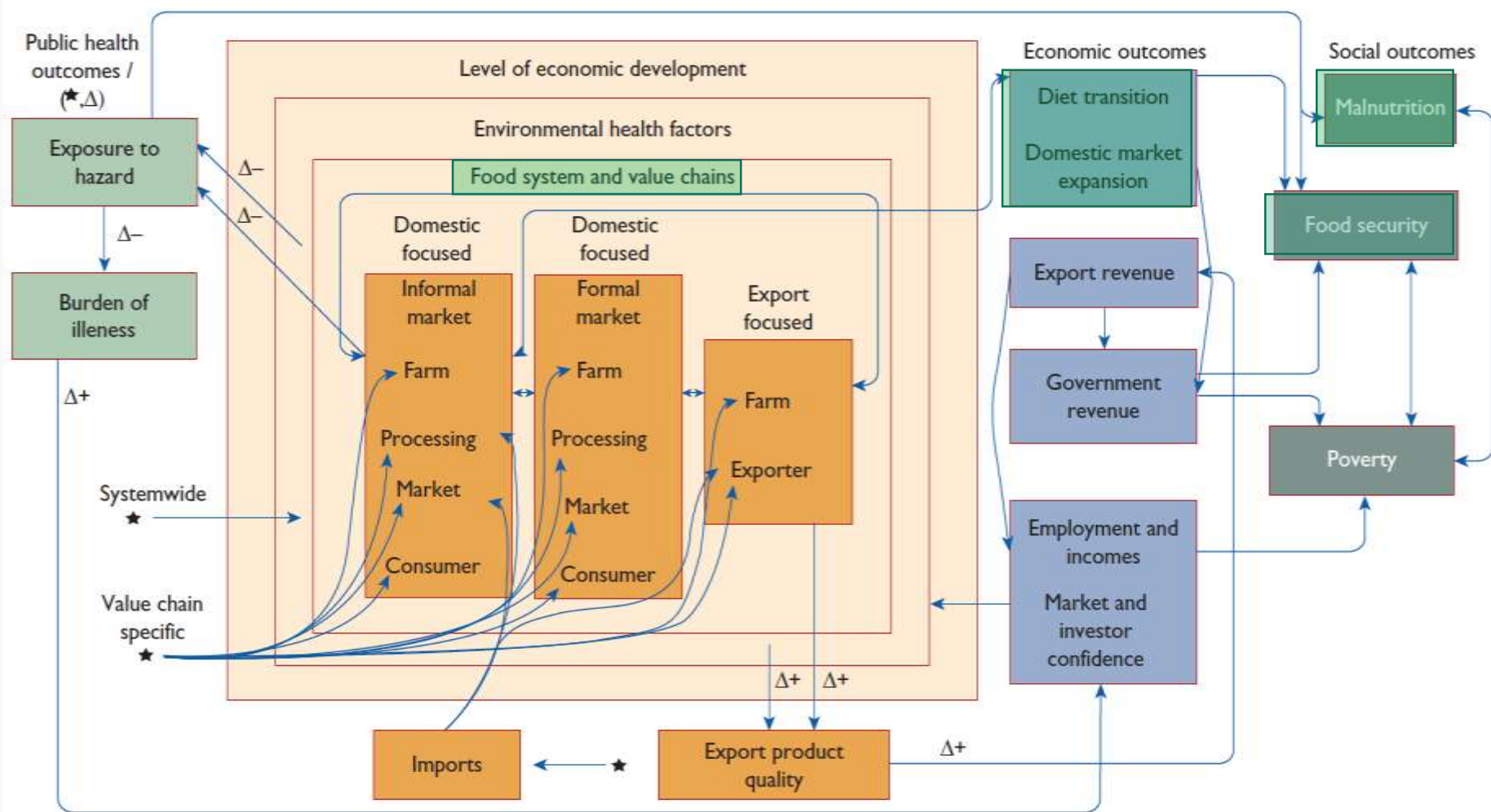


FIGURE 2-2 The components of a food system.

SOURCES: Presented by Kate Clancy on August 7, 2019, from IOM and NRC, 2015.

FIGURE 1.1 Public Health, Economic, and Social Outcomes of Unsafe Food



Source: World Bank.

Effects of Electromagnetic Radiation (Light)

1. Quality Effects: Odors, Flavors, Discoloration
2. Nutritional Effects: Loss of Nutritional Value
3. Human Health Risk Effects

Electromagnetic Radiation (Light) and Nutrients

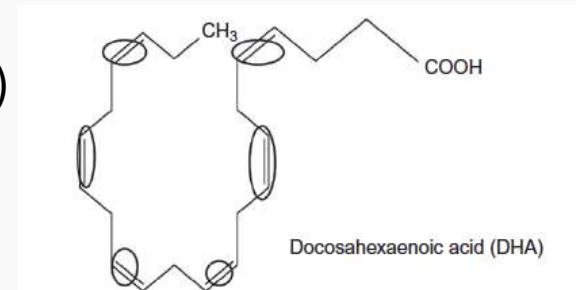
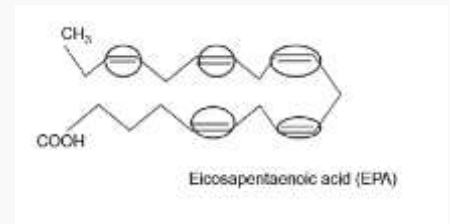
Light, especially UV light leads to the creation of free radicals that react with chemicals, especially those with double-bonds in the molecular structure.

Nutrients

Riboflavin - Vitamin B2,
Pyridoxine - Vitamin B6
Cobalamin - Vitamin B12
Folate - Vitamin B9
Ascorbate - Vitamin C
Retinol - Vitamin A
Ergocalciferol - Vitamin D2
Cholecalciferol, Vitamin D3
Tocopherols - Vitamin E
Fatty Acids
Proteins and Amino Acids

Other Food Compounds

Carotenoids
Chlorophyll
Flavanoids
Anthocyanins
Quercetin
Myoglobin (UV & Visible)



Duncan & Chang *Advances in Food Science*, 2012.

Pasteurization vs. Light

Treatment	Loss of vitamin in milk (%)							
	A		B ₂		C		E	
	Cow milk	Goat milk	Cow milk	Goat milk	Cow milk	Goat milk	Cow milk	Goat milk
Pasteurization	0–17	0–8.8	1–10	1.8–4.0	9.0–44	35–47	1.9–14	0–22.4
UV, 1 pass	8.0–13	1.0–9.0	3.0–10	1.0–2.0	45–74	75–91	16–33	1.0–48
UV, 3 passes	12–20	2.85–20	10.9–17.2	11–11.3	78.4–91.2	91.2–96.6	43.2–57.8	3.5–42.7
UV, 5 passes	20–27.5	12.8–28.9	14.1–26.9	11.9–15.1	90.7–100	96.3–100	52.9–67.5	11.5–61.5
UV, 7 passes	30–32	18.6–42.2	20.3–31.2	17.8–22.6	91.4–100	96.3–100	66.3–70.3	24.2–65.6

¹The milk samples are cow milk (C1, C2, and C3) and goat milk (G1, G2, and G3) samples.

Guneser and Karagul Yuceer, *Journal of Dairy Science*, 2012.



**Table 1—Optimal storage temperature of common perishable food products
(Anonymous 1989, 1990)**

Food product	Optimal storage temperature
Deep-frozen food	
Meat	–25 °C or colder
Poultry	–24 °C or colder
Fish	–29 °C or colder
Fruits and concentrated juices	–18 °C or colder
Vegetables	–18 °C or colder
Frozen food	–20 °C or colder
Frozen butter	
Chilled food	
Fresh meat	–1.5 °C
Meat products	–2 °C
Manufacturing meat	–2 °C
Poultry	–1.5 °C
Fish	in melting ice (0 °C to –0.5 °C)
Dairy products	0 °C to 2 °C
Fruits and vegetables	
Low temperature (apple, blueberry, carrot, lettuce, etc.)	0 °C to 2 °C
Moderate temperature (carambola, melon, pumpkin, etc.)	6 °C to 9 °C
High temperature (banana, cucumber, grapefruit, etc.)	12 °C to 16 °C

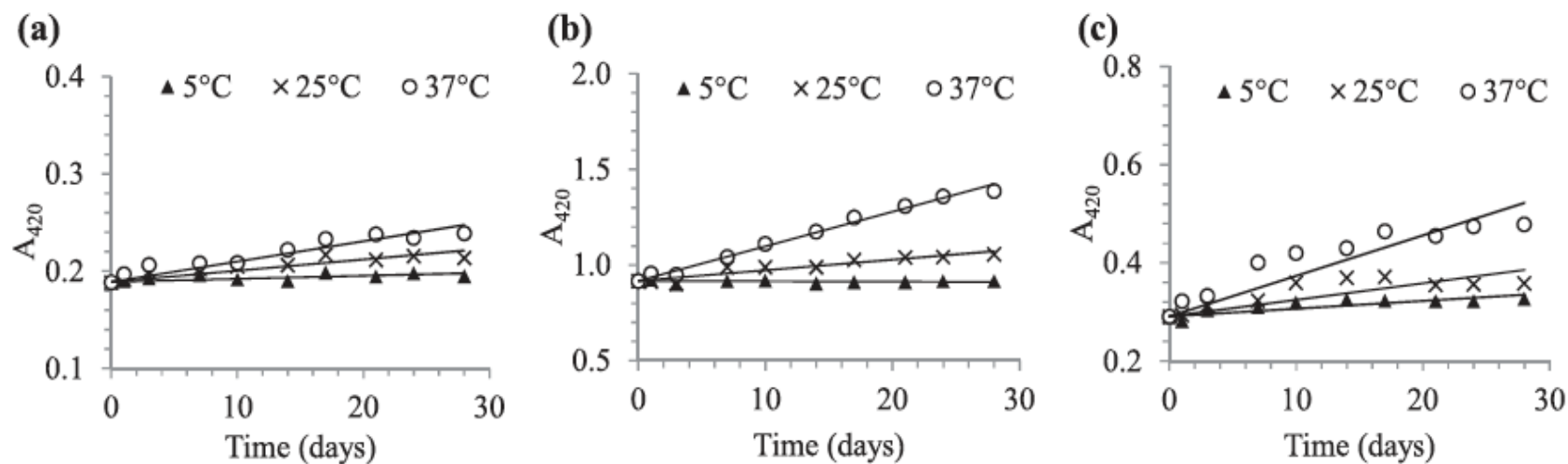


FIG. 1. EFFECT OF STORAGE TIME AND TEMPERATURE ON BROWNING INDEX OF ORANGE (A), PEAR (B) AND GRAPE NECTARS (C)

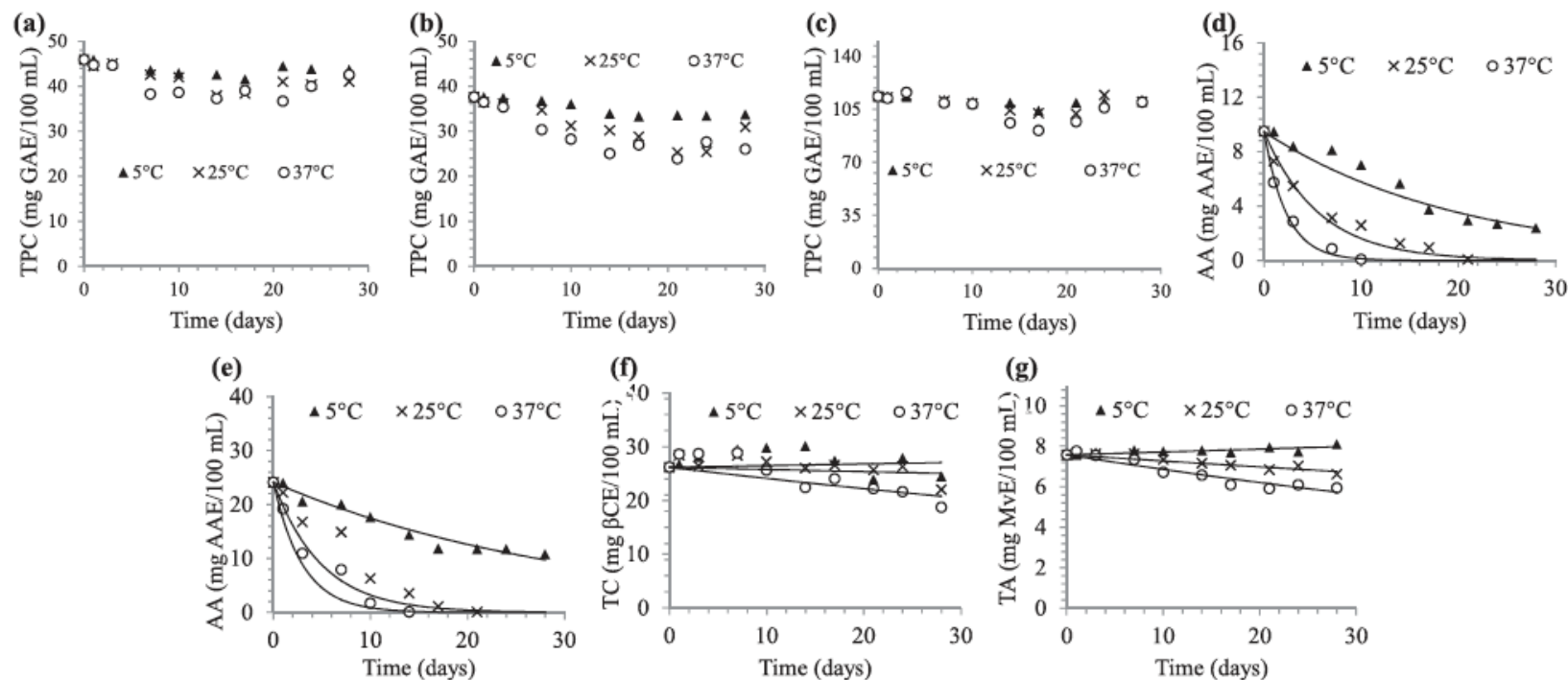


FIG. 2. EFFECT OF STORAGE TIME AND TEMPERATURE ON TOTAL PHENOLIC COMPOUNDS (IN ORANGE (A), PEAR (B) AND GRAPE NECTARS (C)), ASCORBIC ACID (IN ORANGE (D) AND PEAR NECTARS (E)), TOTAL CAROTENOIDS (IN ORANGE NECTAR (F)) AND TOTAL ANTHOCYANINS (IN GRAPE NECTAR (G))

Let's Talk About A Dry Heat

I Do Not Mean Tucson



Issues Related To Drying Food

- Nutritive value, as well as flavor and appearance, is best protected by low temperature and low humidity during storage.
- Sun-dried foods can be pasteurized by heating them in an oven at 175 degrees Fahrenheit (10 minutes for vegetables cut small, 15 minutes for fruits).

Issues Related To Drying Food

- Dried foods can be stored for a long period.
- Conventional methods (long time at elevated temperatures) lead to loss of nutritional value and sensory characteristics
- Improper use of the preservation methods after dehydration may create food safety risks, quality deterioration, and a short product shelf life.

Nutritional Issues Related To Drying Food

- Vitamins A and C content decreased by heat and air.
- Sulfite treatment prevents the loss but causes the destruction of thiamin.
- Blanching reduces the loss of thiamin and vitamins A and C during dehydration and storage but results in some loss of vitamin C and B-complex vitamins as well as the loss of some minerals, because these are all water soluble.
- Dried foods have more calories on a weight-for-weight basis because of their nutrient concentration. For example, 100 grams of fresh apricots has 51 calories, whereas 100 grams of dried apricots has 260 calories.

The Market for Dry Fish

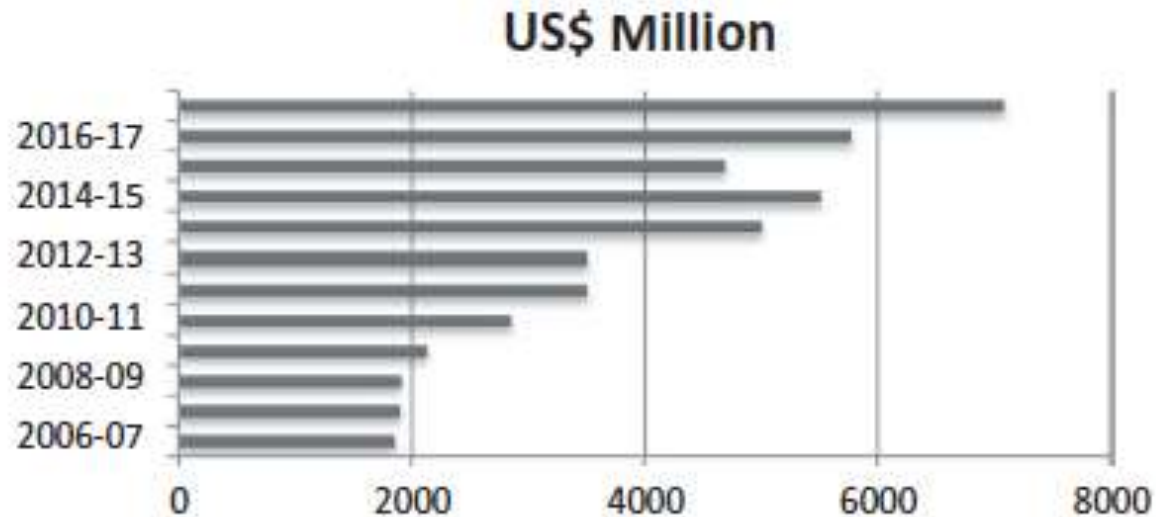


Figure 1. Export data (value wise) of dry fish from India.

Siddhnath et al, *Food Reviews International*, 2020.

The Market for Dry Fish

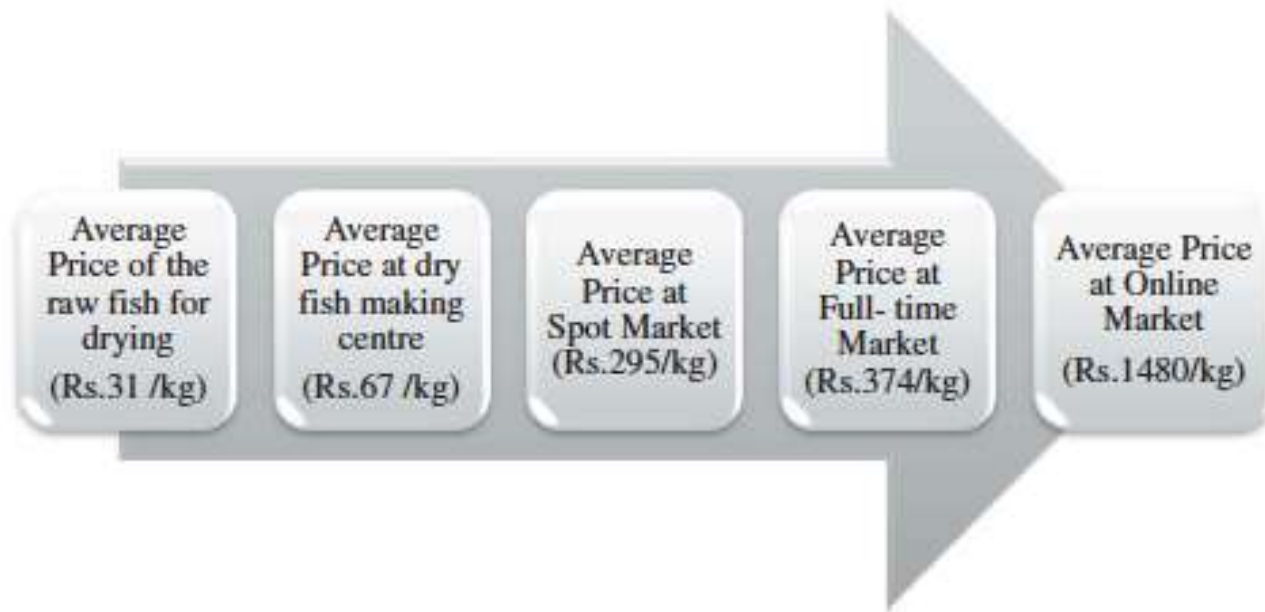
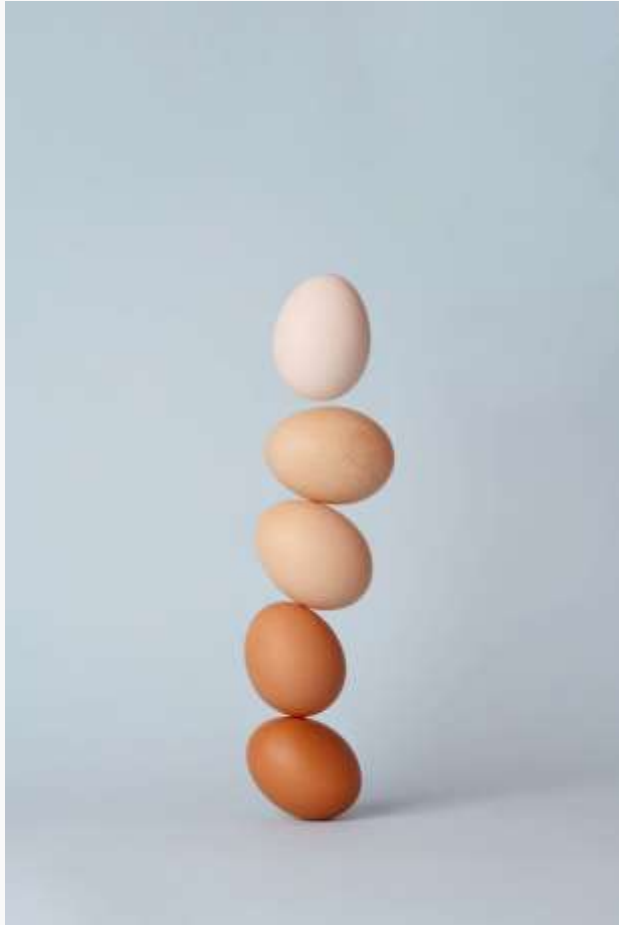


Figure 4. Market prices for different dry fishes in and around Kolkata (India).

Siddhnath et al, *Food Reviews International*, 2020.

Egg Production, Processing and Storage: A Balancing Act for Nutritionists



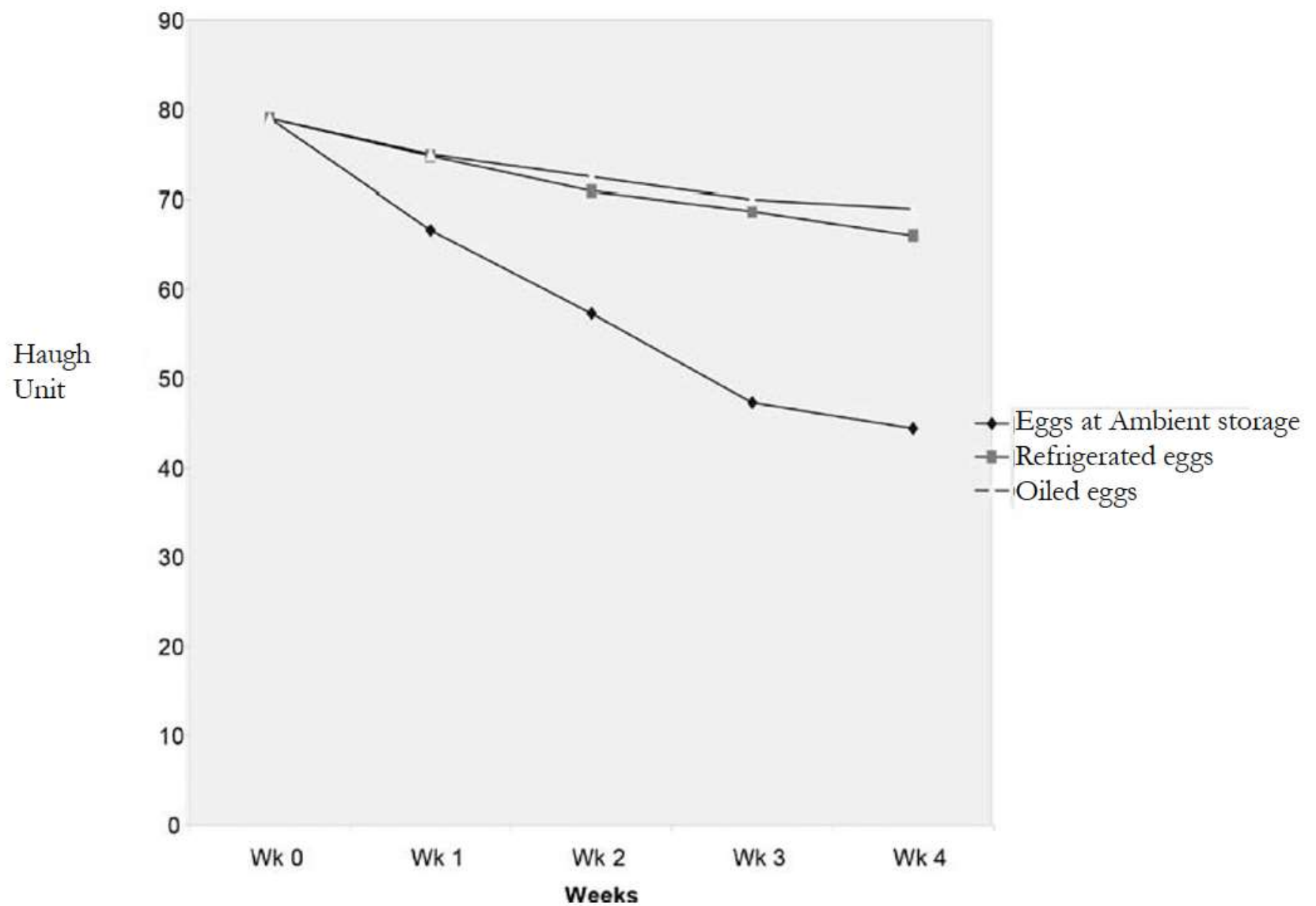
Overall shell eggs lose very few nutrients when stored properly.

Quality of eggs stored at room temperature deteriorates at a much faster rate than does the nutritional value.

Thiamin can deteriorate over time.

Protein not effected by appropriate drying.
Xanthophylls in yolk decrease with storage.

Drying with too much heat can lead to Maillard Reaction and decrease protein availability.



Eke et al, *Nigerian Food Journal*, 2013

Table 3: Microbial profile of eggs during storage

Treatment	WK0 (CFU/ml)	WK2 (CFU/ml) TPC	WK4 (CFU/ml)
Ambient	5.0×10^3	1.4×10^5	2.8×10^7
Refrigerated	5.0×10^3	2.0×10^4	1.1×10^4
Oiled	5.0×10^3	3.0×10^3	7.2×10^4
		YMC	
Ambient	9.0×10^2	3.0×10^5	1.2×10^5
Refrigerated	9.0×10^2	1.0×10^4	
Oiled	9.0×10^2	9.0×10^2	1.5×10^3

TPC = Total plate count, YMC = Yeast and Mould Count, CFU/ml = colony forming unit per ml.

Summary

- Food Processing Has Mixed Effects on the Nutritional Value of Food and Depends of Type of Processing and Food Components.
- Product Quality and Nutritional Status Are Intimately Associated with each other during Food Processing.

Thank You



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Food Safety and the Cold Chain



Introduction

The Cold Chain & Food Safety Meet

“WHO’s first ever global estimates of foodborne diseases find children under 5 account for almost one third of deaths (World Health Organization: WHO, 2015)”



Temperature Control is Critical in Food

Cold Chain

Cold chain is a temperature-controlled supply chain.

Cold Chain Starts on the Farm or Sea Harvest times

- Shading
- Plastic Crates for Air Circulation
- Precooling
- Blast Freezing
- Cold Storage
- Refrigerated Vehicles



Example of Shading in Egypt



Example of Crates Kenya



Example of Cold Room Kenya

Four Key Elements of Food Safety

- **Quality-Safety Culture**

- Leadership is engaged in planning and monitoring the FSMS.
- The company commits visible resources to quality and safety.
- Employee perception surveys show genuine buy-in with safety and quality values.
- People take ownership of quality and safety issues they see.

- **Compliance**

- Regulatory Agencies Requirements



Four Key Elements of Food Safety Cont...

- **Traceability**

- Link production, shipping and receiving data to trace food forward and backward in the food supply.
- Connect Supplier Management tools to track and resolve supplier-related issues for improved supply chain visibility
- Record the history of compliance-related activities for better visibility into source and scope of potential problems.

- **The FSMS as the Foundation**

- Documents
- Employee training
- Audits
- Reporting
- Corrective Action



Critical Areas for Contamination



Business Reason for Food Safety

- Safe & Quality Food - Extends life of Human
- Reduce Food Borne illness – Economically burdens many countries
- Market Access – Export Market Higher Return on product
- Brand Advantage – Over local competitor



Cold Chain Solutions

- Mobile Precooler & Mobile Blast Freezer
- Aldelano Solar Cold Box/Water Maker
- CloudTrack – Temperature Monitoring & Fleet Management Software
- GPS Tracking of Reefer Trucks
- Verizon Connect - GEOFENCE



Conclusion



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Thank You



References

World Health Organization: WHO. (2015, December 3). *WHO's first ever global estimates of foodborne diseases find children under 5 account for almost one third of deaths*. <https://www.who.int/news-room/detail/03-12-2015-who-s-first-ever-global-estimates-of-foodborne-diseases-find-children-under-5-account-for-almost-one-third-of-deaths>. <https://www.who.int/news-room/detail/03-12-2015-who-s-first-ever-global-estimates-of-foodborne-diseases-find-children-under-5-account-for-almost-one-third-of-deaths>

THANK YOU!

Q & A



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