

# Formulation and Characterization of a Novel Artificial Sebum under Conditions of Storage and Use

Aleksandr Stefaniak<sup>1</sup>, Christopher Harvey<sup>1</sup>, Philip Wertz<sup>2</sup>

<sup>1</sup>National Institute for Occupational Safety and Health, Morgantown, WV 26505

<sup>2</sup>University of Iowa, Iowa City, IA 52242

Occupational and Environmental Exposures of the Skin to Chemicals

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# Introduction

- Chemicals contact skin
- Skin surface film liquids (SSFL)
  - Sweat, sebum, cellular debris, intercellular lipids
- Artificial SSFL for *in vitro* modeling
  - Chemical release, partitioning, and permeation
- Representative artificial sebum
  - Composition that closely matches human

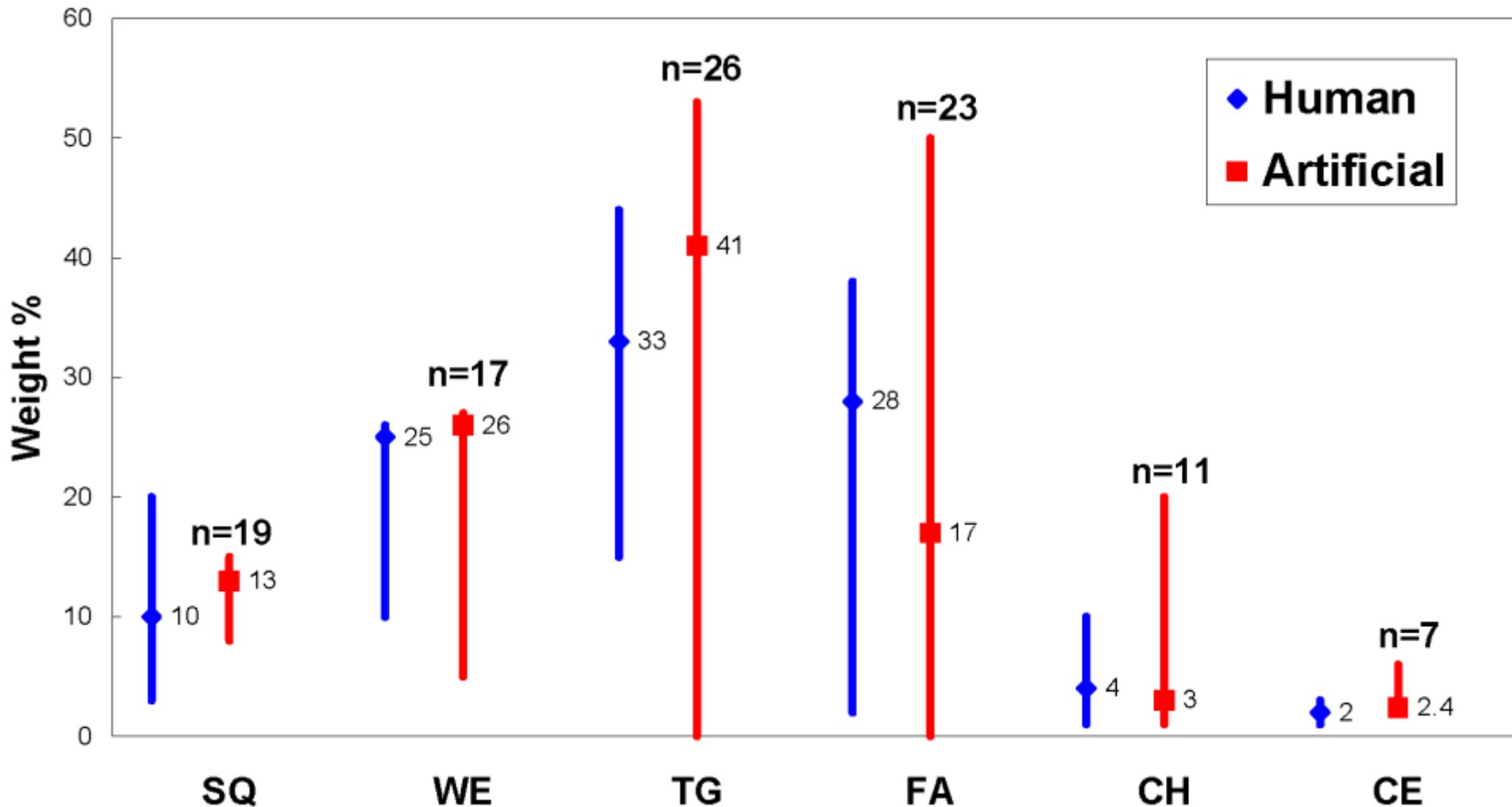
# Human Sebum

- All regions of skin contain sebaceous glands
  - Except palmar and plantar surfaces
- Sebum in gland
  - Squalene (SQ), s/u wax esters (WE), s/u triglycerides (TG)
  - Cholesterol (CH), cholesterol esters (CE), Vit E
- Sebum on skin
  - Triglycerides hydrolyzed to s/u fatty acids (FA)

# Artificial Human Sebum

- 26 formulations published from 1940 to 2009
- Differed from human sebum
  - 80% (21/26) lacked at least one lipid class
  - 20% (5/26) contained all six lipid classes
    - Three lacked s/u WE, TG, or FA
- Lipid concentrations
  - SQ up to 40% higher than median human value
  - TG outside range
  - FA outside range

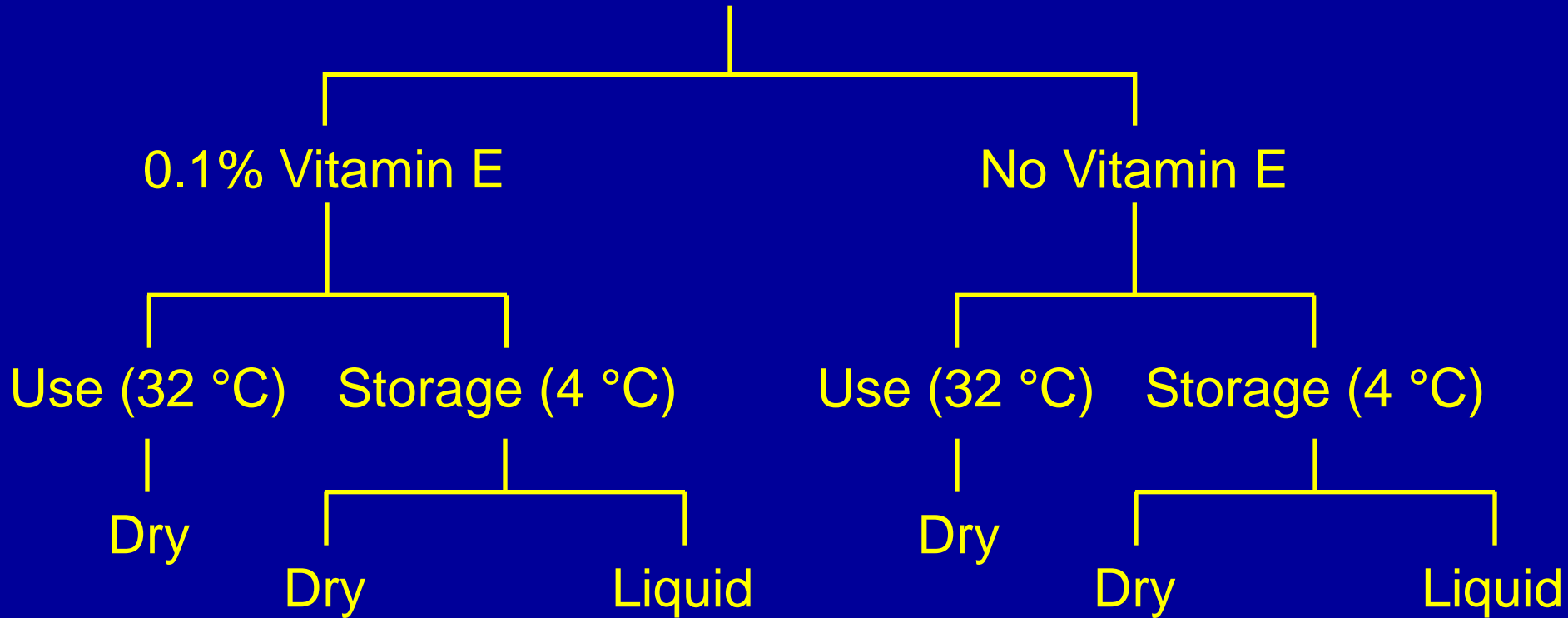
# Human and Artificial Sebum



# Novel Artificial Sebum

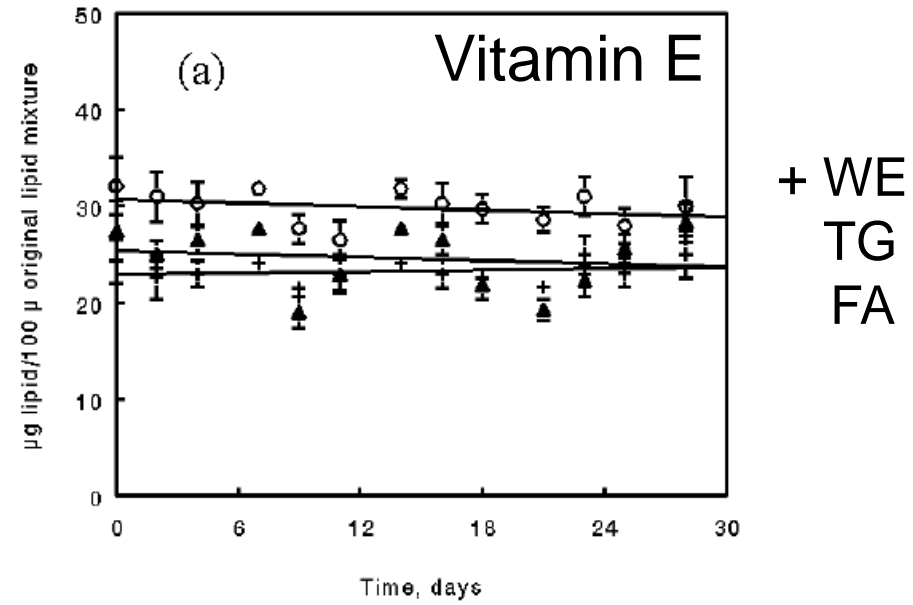
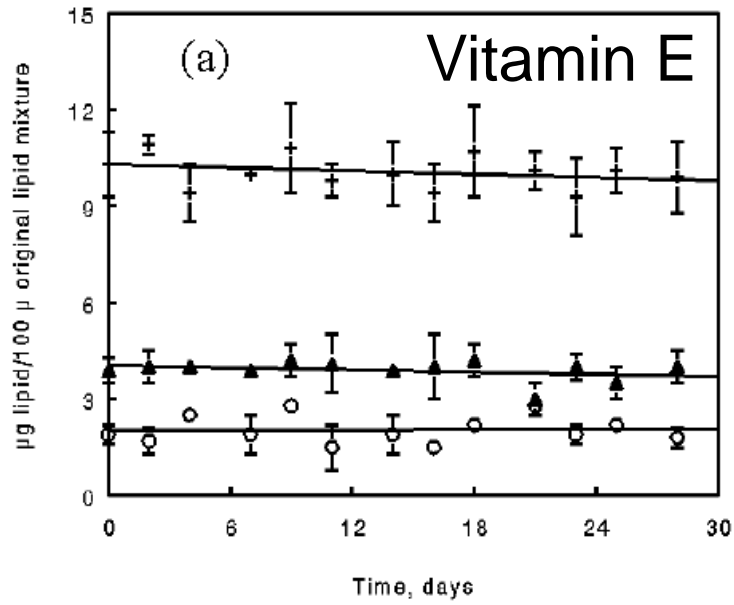
Lipid Class	Type	Constituent	Wt. %
Squalene	-	Squalene	10.3
Wax Esters	S	Palmityl Palmitate	19.4
	U	Oleyl Oleate	4.9
Triglycerides	S	Tristearin	21.4
	U	Triolein	10.7
Fatty Acids	S	Stearic/Palmitic Acids	13.8
	U	Oleic Acid	13.8
Cholesterol	-	Cholesterol	3.9
Cholesterol Esters	-	Cholesteryl Oleate	1.9

Dissolve lipids  
(2:1 chloroform:methanol)

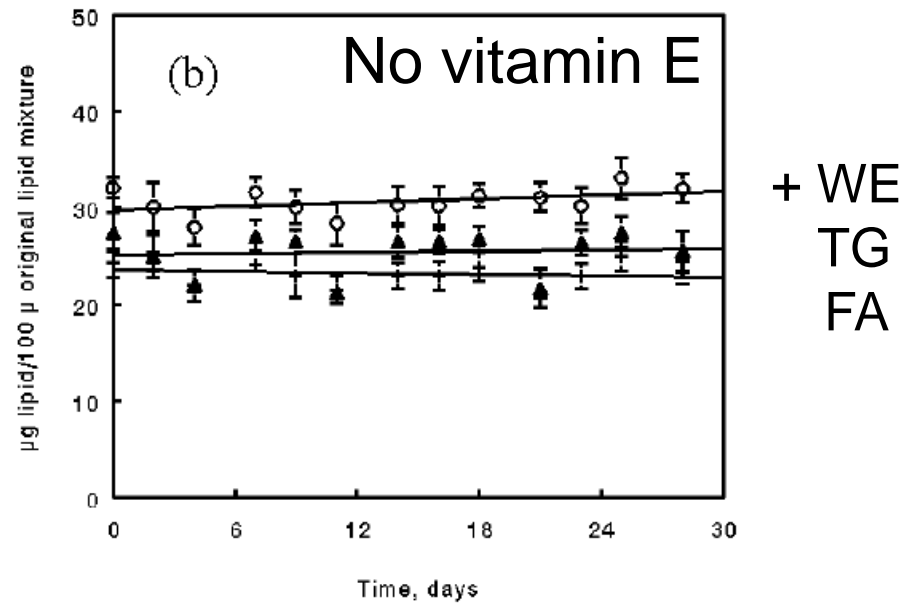
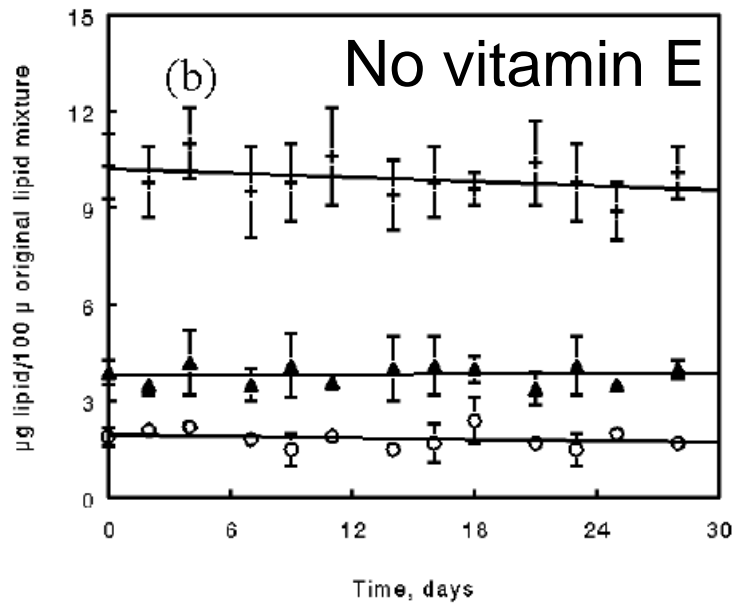


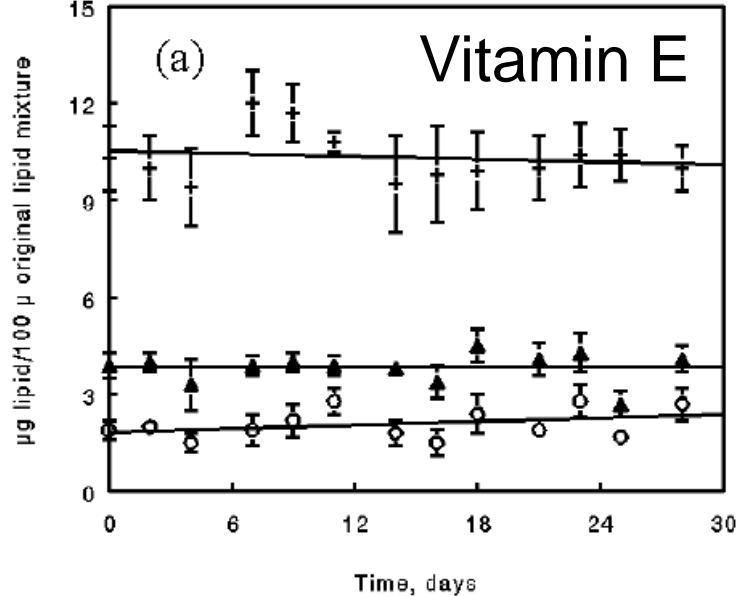
Thin Layer Chromatography (Downing et al. 1969)

t = 0, 2, 5, 8, 10, 13, 15, 18, 20, 23, 25, 28 days

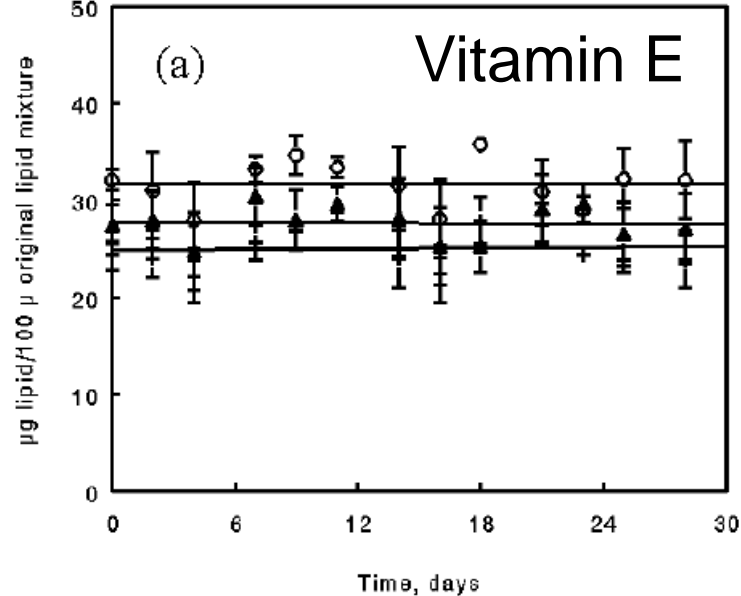


## Solution, 4 C



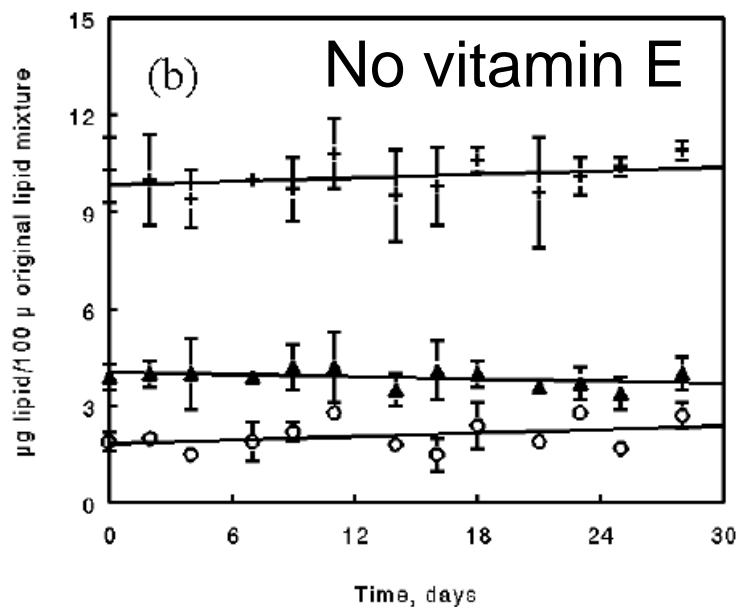


+ SQ  
CE  
CH

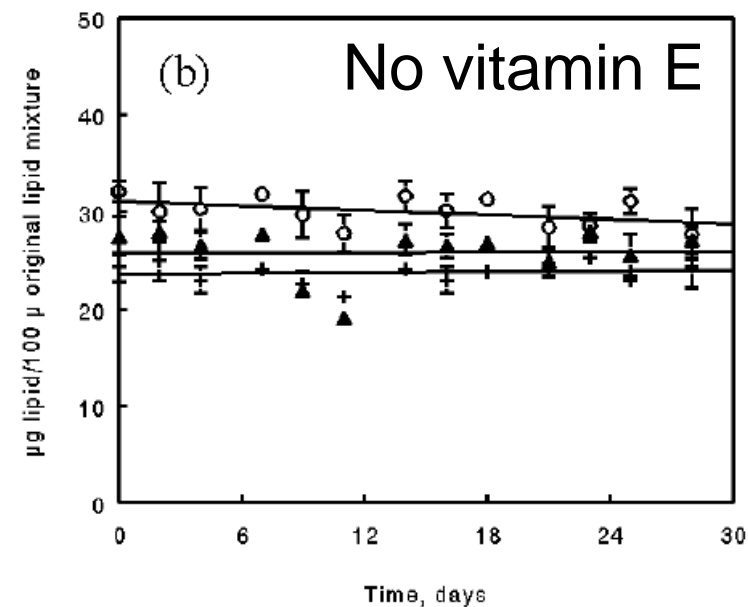


+ WE  
TG  
FA

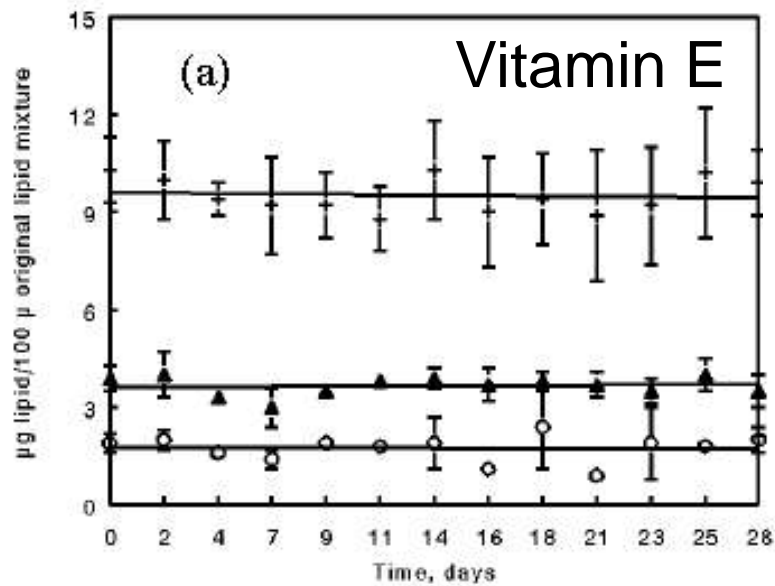
**Dry, 4 C**



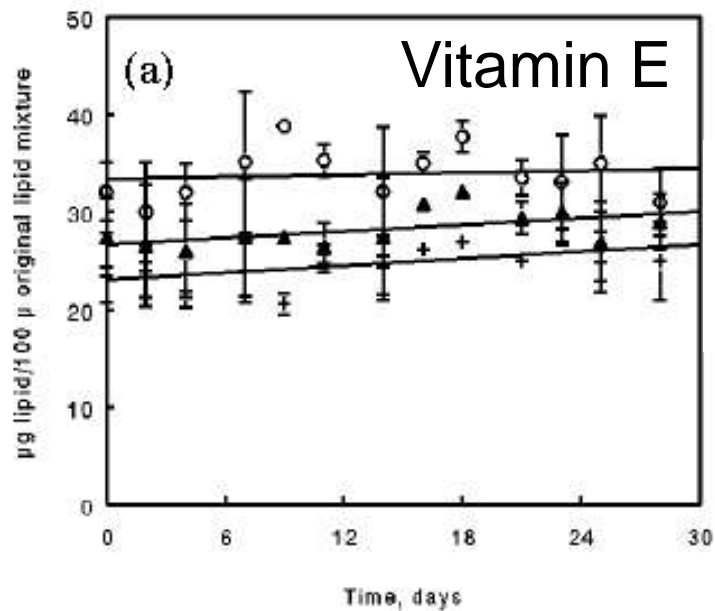
+ SQ  
CE  
CH



+ WE  
TG  
FA

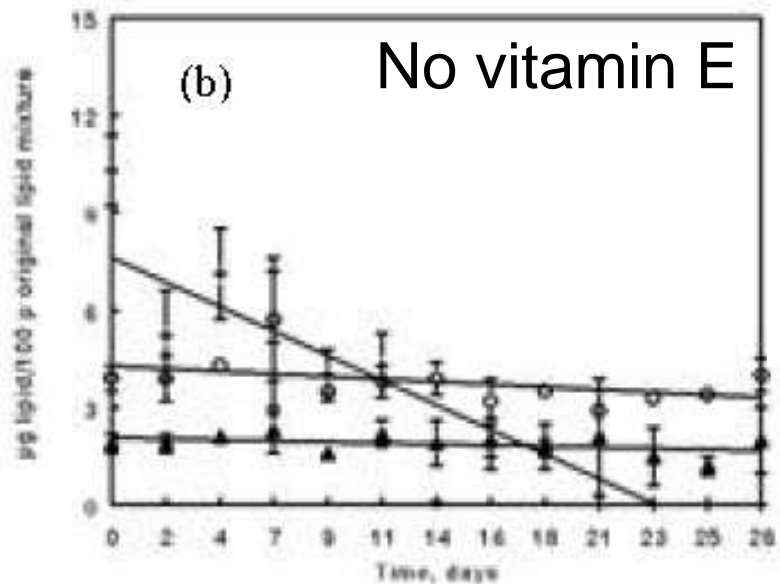


+ SQ  
CE  
CH

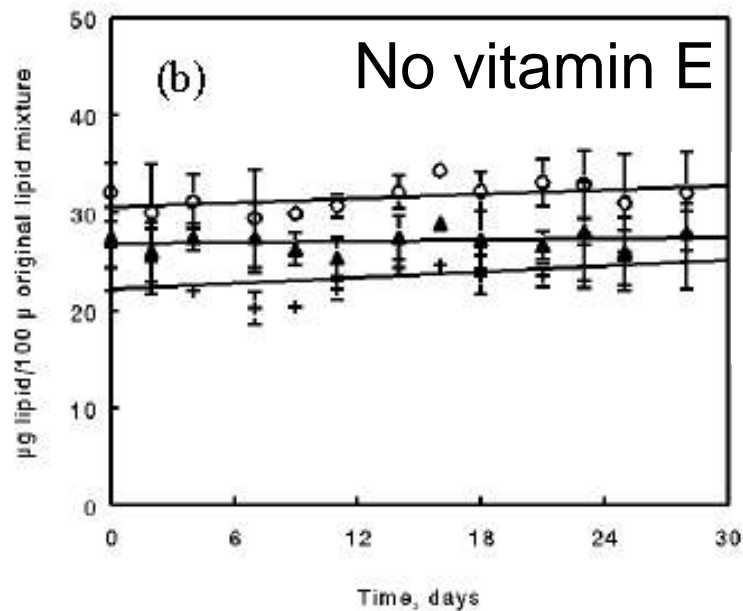


+ WE  
TG  
FA

Dry, 32 C



+ SQ  
CE  
CH



+ WE  
TG  
FA

# Sebum Model Characteristics

- Individual lipids
  - Store refrigerated (liquid or dry)
  - Use at skin temperature with 0.1% vitamin E (dry)
- Variation in human sebum
  - Range TG chain lengths
  - FA branching
- Representative, not comprehensive formulation

# Sebum Model Applications

- Absorption using artificial sebum
  - Pig skin (Simon and Maibach 2000)
  - Neonatal rodent skin (Fluhr et al. 2004)
  - Shed snake skin (Burken et al. 1985)
- Skin lubrication and chemistry
  - Friction, adhesion, wetting (Gerhardt et al. 2009)
- Dissolution of metals using robust SSFL
  - Cobalt, beryllium

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