

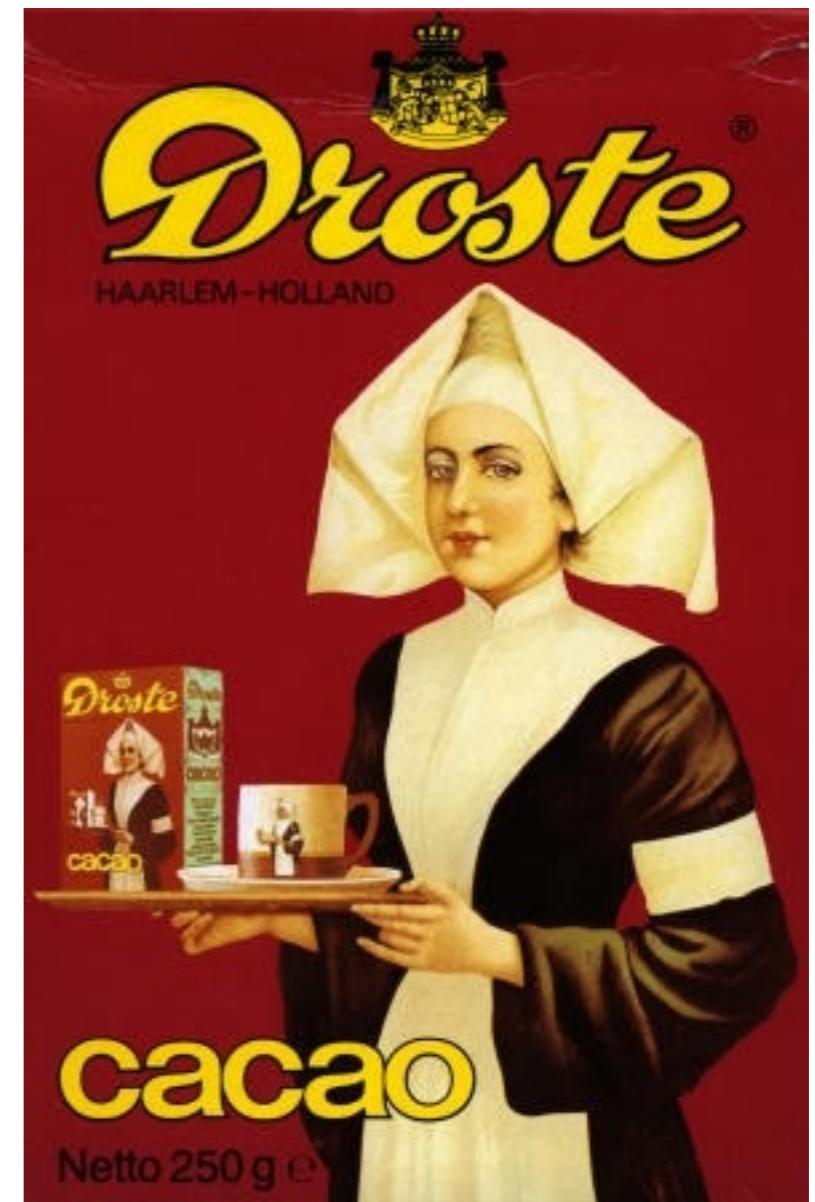
# Drying

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Food for Mankind IUP SEC450

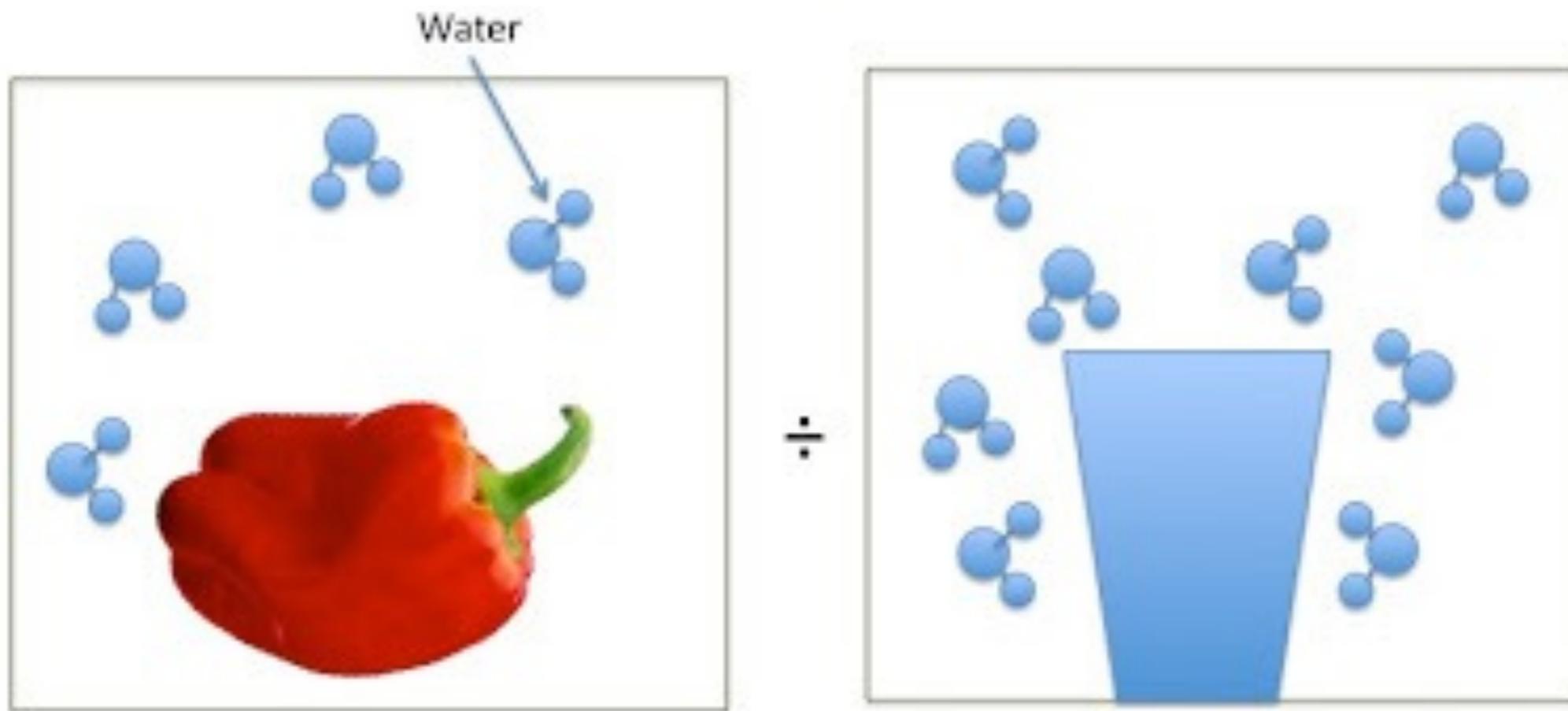
# Drying

- Drying make food dry
- Drying is known since 12,000 BC
- Drying inhibit bacterial growth by removing water using evaporation



**Droste cocoa**  
*probably by Jan Musset*

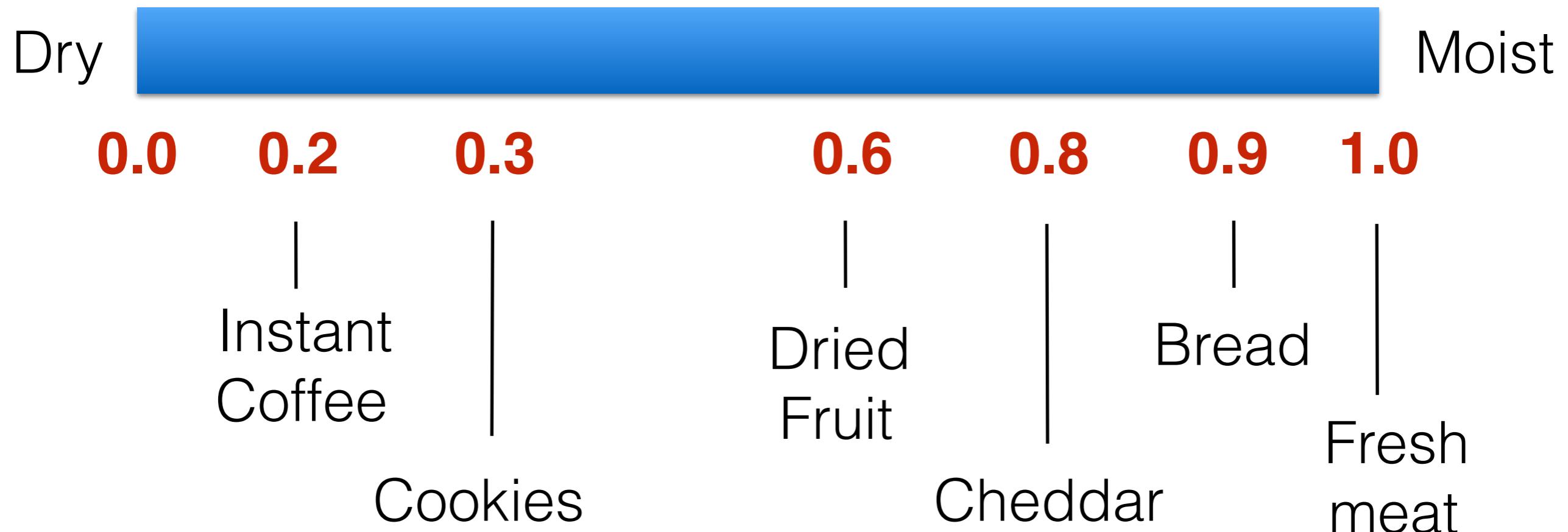
# Water activity level ( $a_w$ )



Vapor pressure of  
water from a food

Vapor pressure of  
pure water

# Water activity level ( $a_w$ )



Source: <http://www.foodsafetysite.com/educators/competencies/general/bacteria/bac5.html>

# Water activity level ( $a_w$ )



**0.6**

|

**Mold, yeast**

Dried fruit

**0.8**

|

**Yeast**

Fruit syrup

**0.85**

|

**Bacteria, mold**

Butter

**0.9**

|

**Bacteria**

Cheese, meat

# Pros

- Lightweight
- Low moisture
- Long shelf life
- Not easily spoiled



# Cons

- Poor visual appeal
- Lose taste after drying
- Take a long time to dry
- Affect nutritional value



# Preparation

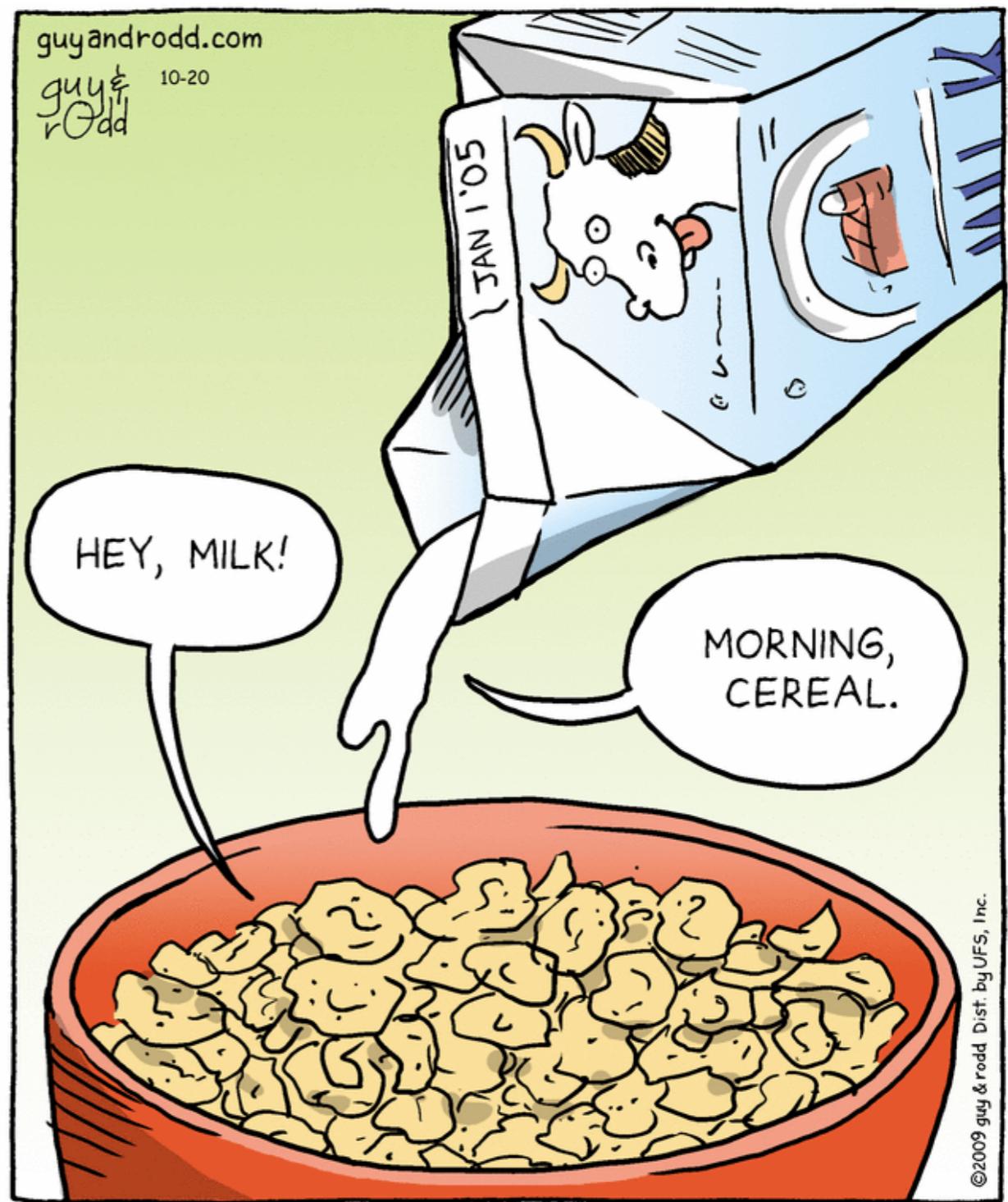
- Drying of vegetables, fruit and meat can be carried out with electrical dehydrators or by sun-drying.
- Preservatives such as potassium metabisulfite, BHA, or BHT may be used, but are not required.  
(without these preservatives may require refrigeration or freezing)



A whole potato, sliced pieces (right),  
and dried sliced pieces (left)

# Drying methods

- Oven
- Dehydrator
- Sun drying
- Freeze drying
- Drum drying
- Spray drying



# Oven

- Can be done in your home
- Costly up to 12 times than canning
- Faster than sun drying
- Use 60-70 °C



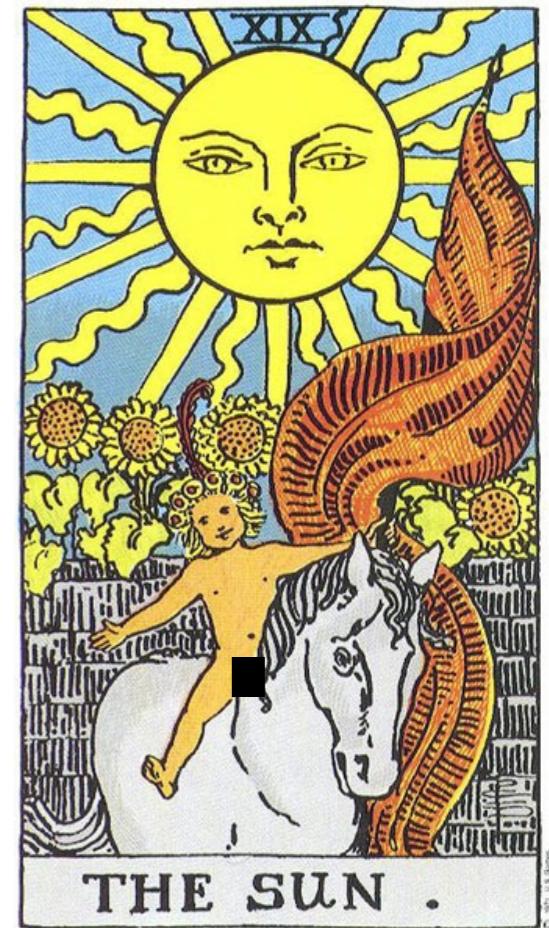
# Dehydrator

- Can be done in your home
- Use less electricity than electric oven
- 50 °C, so take more time than oven
- Automatically controls heat and ventilation



# Sun drying

- Ancient method
- Requires hot sun, low humidity
- Product: raisin, sun dried banana, dried fish



**The Sun**  
by Pamela Colman Smith  
Rider-Waite tarot deck

# Freeze drying

- Food retains shape, texture, color and some of the taste
- Long shelf life
- Lightweight
- Requires expensive equipment
- Product: Coffee, Strawberry, Ice cream, Astronaut food



*Shōyu flavoured Japanese ramen*



# Freeze drying



1. Food are flash frozen  
and placed in vacuum

2. 98% of moisture  
is removed by  
evaporating the ice  
at -45 C

4. When water  
is replaced,  
the food regains  
its original  
flavor, texture  
and appearance

3. The freeze-dried food is  
sealed in moisture and oxygen  
proof packaging to ensure  
freshness

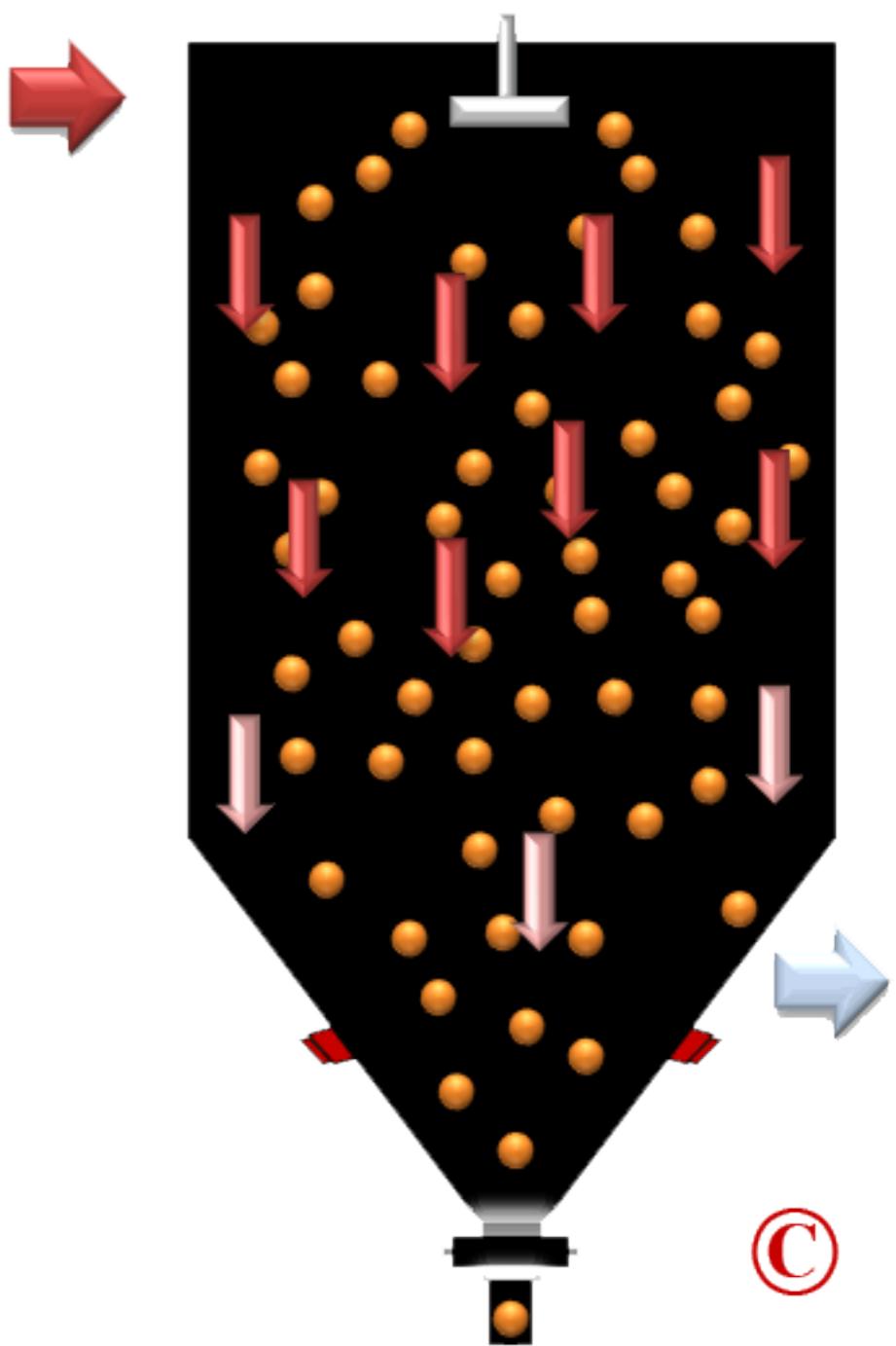
# Drum drying

- Food slurry are dried under low temperature over rotating drum
- The product is then milled to flake or powder
- Most economical way
- Flavour, color and nutrition value are mostly preserved
- Products: Skimmed milk, starch, breakfast cereals



# Spray drying

- Produce dry powder from slurry by drying with hot gas
- The liquid is sprayed into drops
- Hot air is blown into container
- Products: milk powder, coffee, tea



# Food from drying



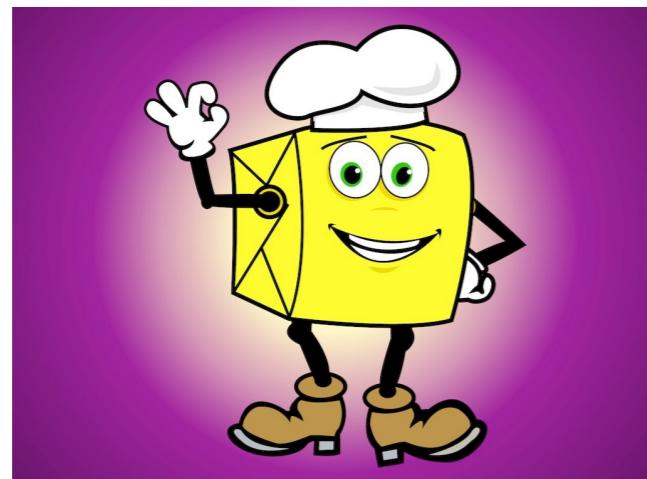
Dried fish



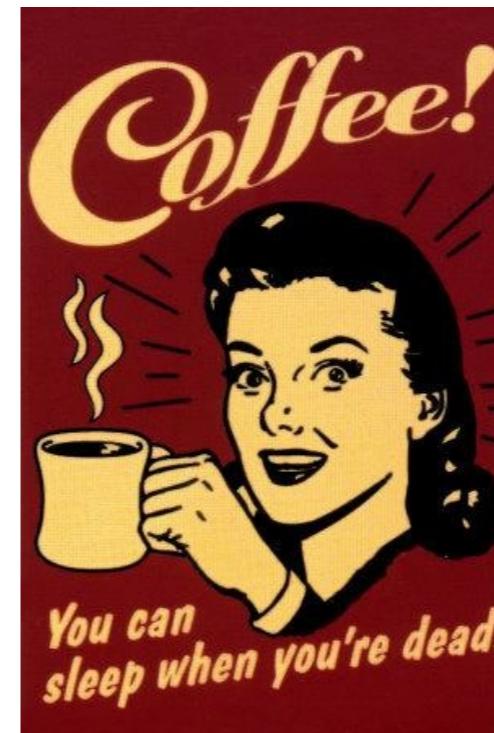
Dried fruit



Instant noodles



Instant soup



Freeze-dried  
coffee

# Beef Jerky

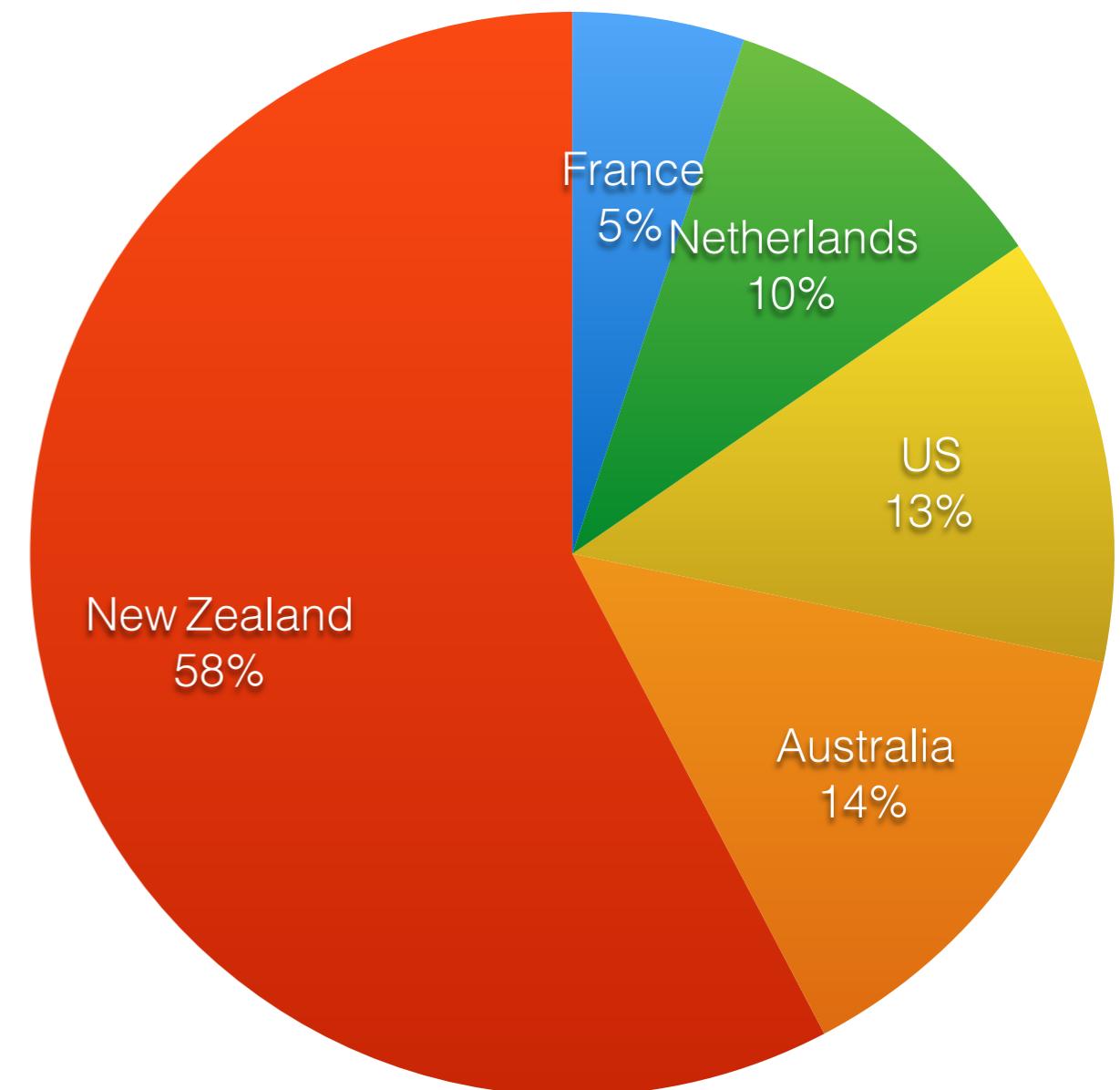
- Dried strip of meat without fat
- Dried and salted over low heat
- Usually seasoned
- Can be stored for months without refrigeration



# Milk powder

- Thai people consume over 100,000 tonnes of milk than local production output in each year.
- Imported milk are used in bottled milk, drinking yoghurt, condensed milk, ice cream, bread, candy, chocolate, etc.
- In 2014, we imported over  $18,418.7M\ THB$  worth of milk

2014 milk import by country



Source: Thailand Food Intelligence Center  
[http://fic.nfi.or.th/food/upload/pdf/6\\_1746.pdf](http://fic.nfi.or.th/food/upload/pdf/6_1746.pdf)

# Milk powder

- Invented in 1802
- Made from spray dried nonfat skimmed, condensed, pasteurized milk
- Longer shelf life without refrigeration
- Ease transportation



# Powdered Eggs

- Made from spray drying
- Can be stored for 5-10 years in optimum condition
- Used in bakery



# Freeze dried strawberry

- Crisp
- Eaten as-is as snack or add water
- Retain flavor, shape and color



# Thank You

*The Persistence of Memory*  
by Salvador Dalí