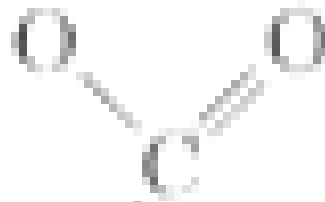
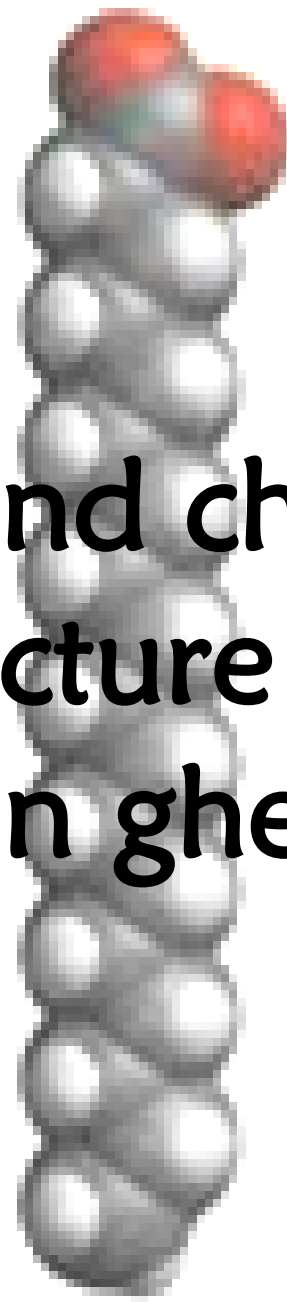


Carboxyl  
group



# Composition and changes during manufacture of fat constants in ghee

Hydrocarbon  
chain

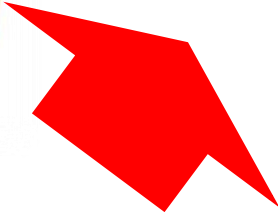
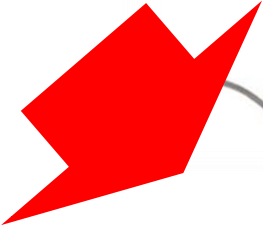


**Competition**

**Quality and  
Special  
Features of  
Product**

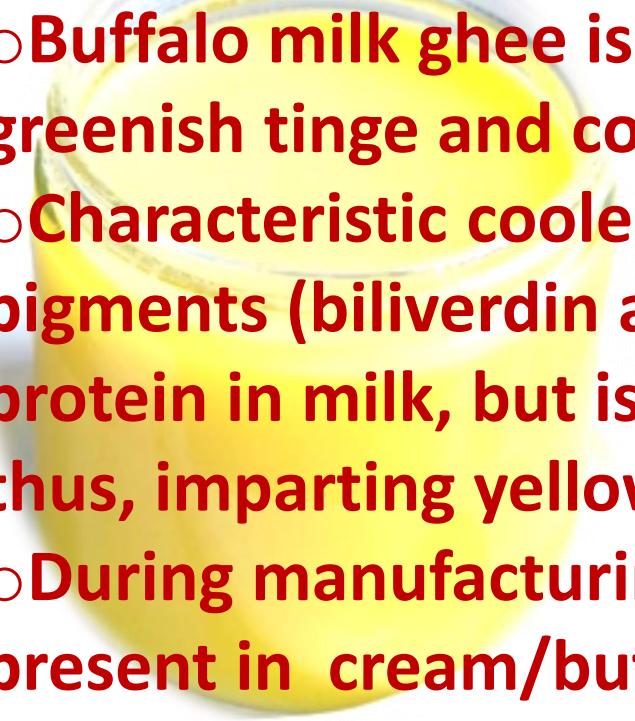



**Brand Value**

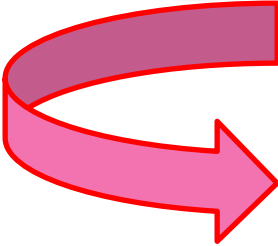
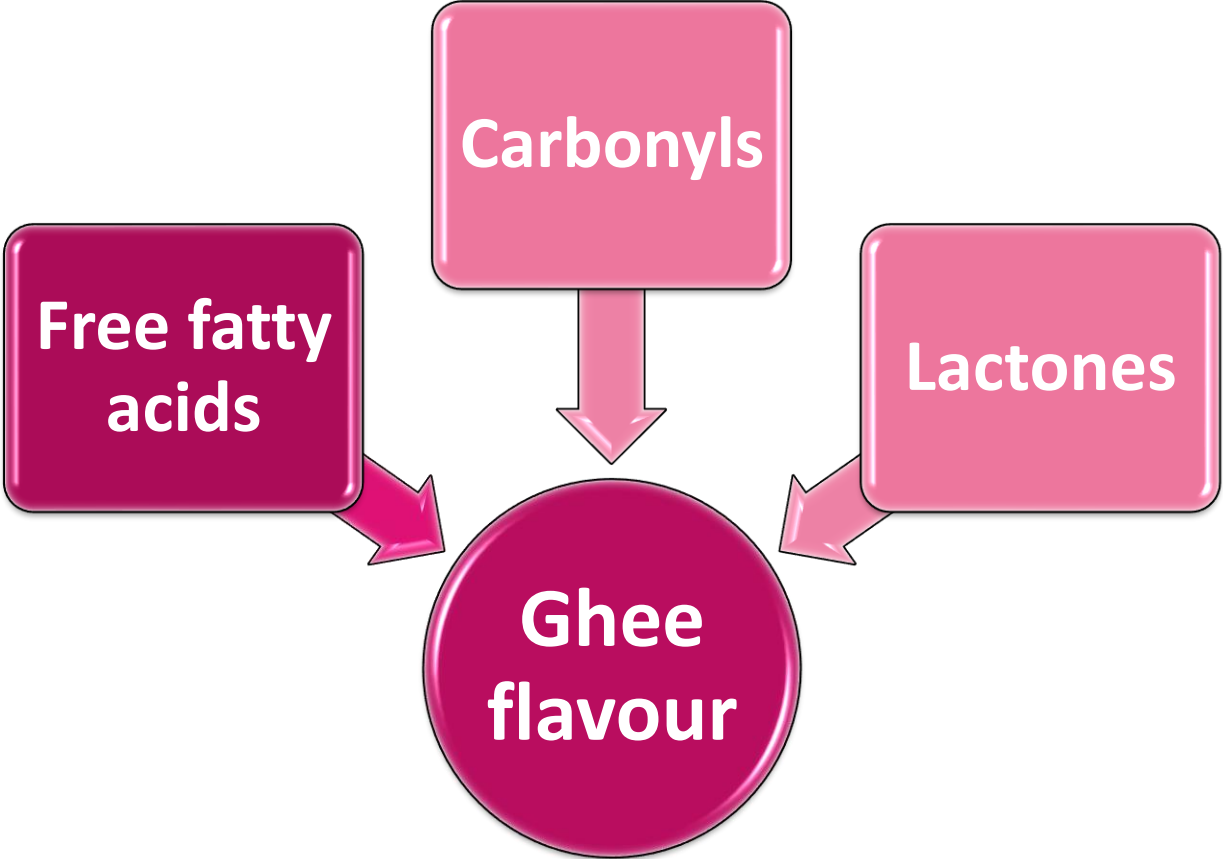


# Ghee composition and changes during manufacture

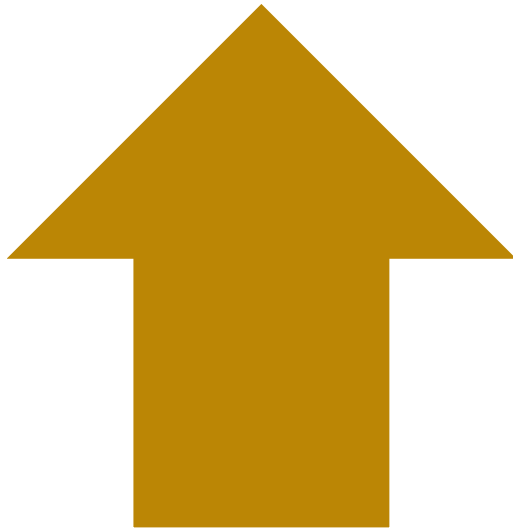
- Ghee majorly consists of milk lipids and richest source of milk fat.
- Constituents of ghee vary with method of its manufacture. It is a complete lipid of 97-98% triglycerides with small amount of di and monoglycerides.
- Fatty acid composition of buffalo milk ghee also varies from cow milk ghee (**butyric acid** is significantly higher in buffalo than cow ghee).
- **Caproic to myristic** are significantly higher in cow than buffalo ghee and **palmitic and stearic** are higher in buffalo than in cow ghee.

- 
- 
- Buffalo milk ghee is white (lack of **carotenoids**) with greenish tinge and cow milk ghee is golden yellow.
  - Characteristic cooler of buffalo fat is due to **tetrapyrozole** pigments (biliverdin and bilirubin); pigment is conjugated to protein in milk, but is released during manufacturing of ghee thus, imparting yellowish-green color to buffalo ghee.
  - During manufacturing, water gets evaporated and fat present in cream/butter getting concentrated and starts settling at bottom during clarification process.
  - Flavour formation in ghee happens during fermentation of cream and clarification process.
  - Colour development and granulation happens during clarification for subsequent packaging of ghee.

# Flavour Formation In Ghee:



- ✓ Method of preparation
- ✓ Temperature of clarification
- ✓ Storage period



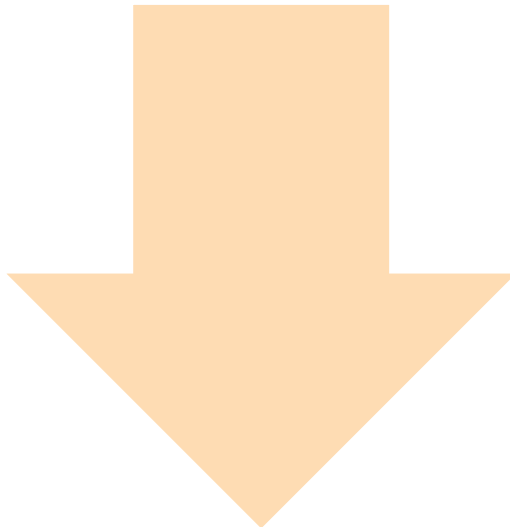
## **Carbonyls:**

Quantity of carbonyls is directly proportional to temperature of clarification.

'Head space' and 'volatile' carbonyl content of fresh desi cow ghee is higher than buffalo ghee.

Total carbonyl content of fresh desi buffalo ghee is higher than cow ghee.

Carbonyl content increase during storage.



## **Lactones:**

Higher in buffalo ghee.

Highest in direct cream (DC) ghee, followed by creamery butter (CB) and lowest in desi ghee.

Clarification butter at 100-120 C double lactones level from butter.

Lactone level in ghee rise on storage.

# Flavour Components of Ghee:

○ **Formation of flavour components are due to**

**(i) Heat interaction between the native carbohydrates and protein system of cream**

**(ii) Due to heat effect on unfermented residue as well on fermented metabolic products formed by ripening process.**

## Major flavor components in ghee

Components	Cow ghee	Buffalo ghee
Total carbonyls ( m/g) Alkan-2-ones = 90% Alkanals = 6% Alk-2-enals = 2% Alka-2, 4 dienals = 2%	7.2	8.64
Volatile Carbonyls ( m/g)	0.33	
Head-Space Carbonyls (gas stripped) m/g)	0.035	0.027

# Flavour in ghee is due to four different mechanisms:

## Hydrolysis

(Free fatty acid formation)

## Oxidation

(Saturated and unsaturated aldehyde, ketones, alcohols and hydrocarbons)

## Decarboxylation

(Alkan-2 -Ones)

## Dehydration and Lactonization

(Lactones)

Lactose, citrate and glucose were responsible for increase in ghee flavour components.



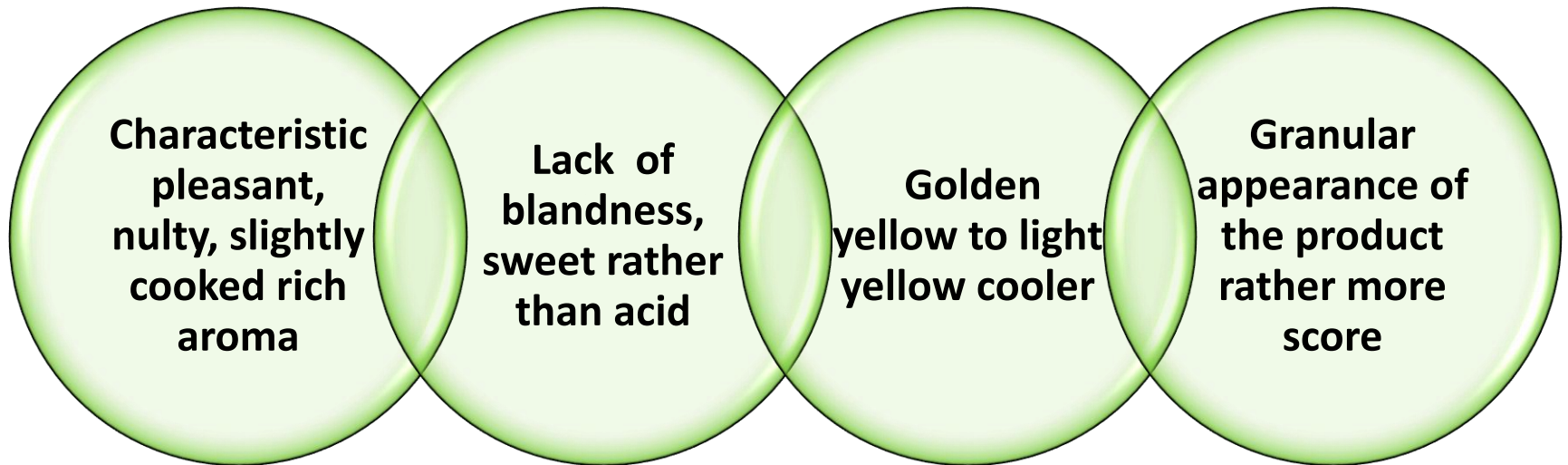
## 1. Texture of ghee:

□ Storage of ghee at room temperature crystallizes into 3 distinct fractions/layers: **(i) Oily (ii) granular semi-solid at the bottom (iii) hard flakes portion floating on surface and sticking to sides of container.**

□ Layer formation can be prevented by storing at 20 C or below immediately after preparation. Ghee thus, solidified can subsequently be stored at higher temperature without formation of layer.

□ Liquid portion of ghee varies with storage temperature, shape and size of container, repeated heating and agitation, ripening of cream/butter, storage and handling etc.

## 2. Market Quality of Ghee



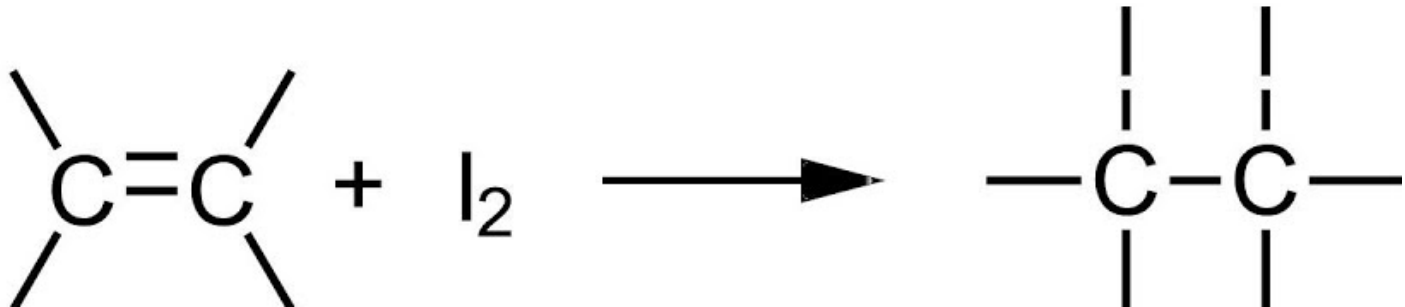
**Chemical and other physical preventers are evaluated to judge the quality of ghee and also to prevent adulteration of ghee:**

### **1. Refractive Index:**

- ❖ **Ratio of the velocity of light in vacuum to the velocity of light in the sample medium.**
- ❖ **In case of milk fat reading is normally made at 40°C using Abbe refractometer and its values range from 1.4157-1.4566. This value is low in comparison to other fats and oils.**
- ❖ **RI of ghee is influenced by both molecular weight and degree of saturation of component fatty acids.**
- ❖ **RI could be used as indicator of adulteration.**

## 2. Iodine Number:

- ❖ Number of grams of iodine absorbed by 100 g of fat under specified conditions.
- ❖ Iodine number for milk fat falls within the range of 26-35 which is low in comparison to other fat and oils. This is estimated using Wijs method.
- ❖ One molecule of halogen compound is absorbed by each unsaturated linkage and the absorption is expressed as the equivalent number of grams of iodine absorbed by 100 g of fat.



### **3. Reichert-Meissl Number (RM Number):**

- ❖ Number of ml of N/10 sodium hydroxide required to neutralize the steam volatile water soluble fatty acids distilled from 5 g of ghee under precise conditions.
- ❖ Primarily a measure of butyric acid and caproic acid.
- ❖ Value for milk fat ranges between 17-35 and it is above that of all other fats and oils. Therefore, milk fat contains more of these acids than any fats.

### **4. Polenske Number:**

- ❖ Number of ml of N/10 Sodium hydroxide required to neutralize steam volatile water insoluble fatty acids distilled from 5 g of fat under precise conditions.
- ❖ Caprylic acid, capric acids (steam volatile and insoluble in water) are indicated mainly in Polenske number and it ranges from 12-24 for milk fat.

## **5. Saponification Number:**

- ❖ Number of milligrams of potassium required to saponify one gram of fat.
- ❖ Value ranges from 210-233 and more often falls in range of 225 - 230.
- ❖ This constant is an indication of average mol. wt of fatty acid present.
- ❖ Detects presence of mineral oils (liquid paraffins in ghee as they are not acted upon by alkali and such a sample doesn't form a homogeneous solution on saponification).

## **6. Melting Point:**

- ❖ Melting point for milk fat ranges from 30 C to 41 C.

## **Factors Affecting the Market Quality of Ghee**

- 1. Raw-materials (Milk, Dahi, Cream, Butter) used for ghee making: Milk used should be clean, fresh and strained. Use of ripened cream, butter improves flavour score of ghee.**
- 2. Method of preparation and temperature of clarification: Flavour compounds of ghee vary according to its method of preparation. Eg., desi methods have more volatile carbonyl compounds than cream method. Temperature of clarification also has influence on quantity of carbonyl compounds and lactones formation during ghee production.**

- 3. Type of feed:** Main factor affecting variation in fatty acid composition of milk fat. Roughages in feed mainly consist of cellulose contribute to formation of fatty acid of 4-16 carbon chain length and lipid content of feed contributes to formation of long chain fatty acid (C16 and above). Animals fed with cotton seed meal will have high amount of C10 and C12 fatty acids.
- 4. Season:** In winter and monsoon, granulation is more due to changes in fatty acid profile. Winter ghee showed higher acidity, melting point and grain size whereas; in summer the saponification value is higher.



## Grading of Ghee

- ❑ Quality of ghee can be judged by physical and chemical analysis.
- ❑ Customer can only perceive appearance, taste and aroma of ghee. Therefore, grading i.e. classification according to its quality and purity is necessary to assure customer.
- ❑ The Agricultural Produce (Grading & Marking) Act, 1936 empowers Central Government to fix quality standards, known as '**AGMARK**' standards and to prescribe terms and conditions for using seal of 'AGMARK'.
- ❑ 'AGMARK' is a derivative of "Agricultural Marketing".

# Objectives of AGMARK:



1.

- To assure consumer a producer of pre -tested quality and purity

2.

- To enable manufacturers of high grade product to obtain better returns

3.

- To develop orderly marketing of commodities by eliminating malpractices when transferring from producer to consumer.

**AGMARK is a certification mark of Government of India to ensure purity and quality of Agricultural and allied products in India**

# AGMARK Ghee Specifications

□ Grade designation marks for ghee- The grade designation mark shall consist of label specifying name of commodity, grade designation and bearing design consisting of an outline map of India with word —'AGMARK' and figure of rising sun with words produce of India.

Grade	Letter and Circular border colour
Special	Red
General	Green
Standard	Chocolate

## AGMARK grades of ghee

- Labels shall be printed on watermark paper of Government of India and shall have micro tint back ground bearing words "Government of India" in olive green color.
- Each label shall have printed thereon a serial number along with a letter or letters denoting the series, e.g. A054987.
- Each label shall have printed thereon the approx. weight content of package on which it is affixed.

# Design of Label

Grade designation marks for ghee- The grade designation mark shall consist of label specifying name of commodity, grade designation and bearing design consisting of an outline map of India with word —'AGMARK' and figure of rising sun with words produce of India.



The word "Regional" shall be printed on each label used on a package of ghee not conforming to normal physical and chemical constants

1. Special Grade 2. General Grade 3. Standard Grade

## AGMARK standards of ghee

Parameters	Special Grade	General Grade	Standard Grade
Baudouin Test	Negative	Negative	Negative
Butyro-refractometer reading at 40°C	40.0- 43.0	40.0- 43.0	40.0- 43.0
Reichert Meissl value	Not less than 28.0	Not less than 28.0	Not less than 28.0
Polenske value	1.0 - 2.0	1.0 - 2.0	1.0 - 2.0
Moisture content	Not more than 0.3%	Not more than 0.3%	Not more than 0.3%
Percentage of Free Fatty Acid (as oleic acid)	Not more than 1.4	Not more than 2.5	Not more than 3.0



## Requirements of high grade ghee

Taste and aroma

Colour

Granularity

- ❑ **Flavour:** High grade ghee should have natural sweet and pleasant odour, an agreeable taste, free from rancidity and objectionable flavour and pleasant, nutty, slightly cooked aroma.
- ❑ **Texture:** Large uniform grains with very little liquid fat is desirable. Upon melting, should be clear, transparent, free from sediment and foreign colouring matter.
- ❑ **Colour:** Uniform throughout, bright yellow for cow milk ghee and white with or without a yellow or greenish tint for buffalo milk ghee.

## Score card of ghee

Parameters	Score
Flavour	45
Texture	10
Acidity (Oleic)	25
Colour	10
Freedom from suspended matter	5
Package	5

# Defects in Ghee and their Prevention

## Flavour Defects

Defects	Causes	Prevention
Smoky	Smoky fire used for boiling of milk/cream/butter	Use non-smoky fire for boiling milk/cream/butter
Overcooked Or bunt	Excessively high temperature of clarification	Optimum temperature of clarification of ghee
Undercooked	Excessively low temperature of clarification	Optimum temperature of clarification of ghee
Rancid	Fat hydrolysis due to lipase action in milk/cream/curd/butter/ghee	Inactivation of lipase by proper heat treatment  Clarify at optimum temperature which ensures minimum moisture content in ghee
Oxidized/oily/ metallic	Fat oxidation due to direct contact of milk/curd/cream/butter/ghee with copper or iron, exposure of these product to sunlight	Storage of the milk/curd/cream/butter/ghee in properly tinned or aluminum alloy/ss vessels  Filling ghee upto the brim to minimize the headspace & use opaque containers  Avoid ghee storage at high temperature (>210C) & avoid long storage

## Texture Defects

Defect	Causes	Prevention
Greasy	Rapid cooling of hot ghee after clarification	Slow cooling of hot ghee after clarification
	Subjecting ghee to further heating and cooling treatment after preparation	Avoid further heating and cooling of ghee after preparation

## Appearance Defects

Defects	Causes	Prevention
Burnt colour	Excessively high temp. of clarification	Optimum temp. of clarification of ghee
Higher Sediment	Incorrect straining of ghee	Correct straining of ghee



# Adulterants in Ghee

Adulteration of ghee in India is more prevalent especially in unorganized sector. Being most expensive fat, people adulterate the product to make profits.

**ADULTERANT**

Vanaspati  
(Hydrogenated  
vegetable oil))

Refined (de-  
odourized)  
vegetable oil

Animal body fat

Government made compulsory that all Vanaspati must contain a maximum of 5% of sesame oil which can be identified in ghee by a simple colour test (known as Baudouin test). Adulteration of ghee with Vanaspati an extent of 3% can be detected.