



# Designer eggs and meat through nutrient manipulation

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## Designer eggs and meat through nutrient manipulation



## Designer eggs and meat

- ▶ Designer food refers to the food that is designed to have some health benefits other than its traditional nutritional value.
- ▶ Designer eggs are those in which the **content has been modified** from the standard egg
- ▶ ‘Designer food’, ‘functional food’ and ‘fortified food’ are synonyms.

### Composition of chicken eggs

Egg shell (%) 10.5

Egg yolk (%) 31.0

Egg white (%) 58.5

Energy (kcal / 100 g) 162

Protein (g) 12.1

## Designer eggs and meat

### ► Composition of chicken eggs

Egg shell (%) 10.5

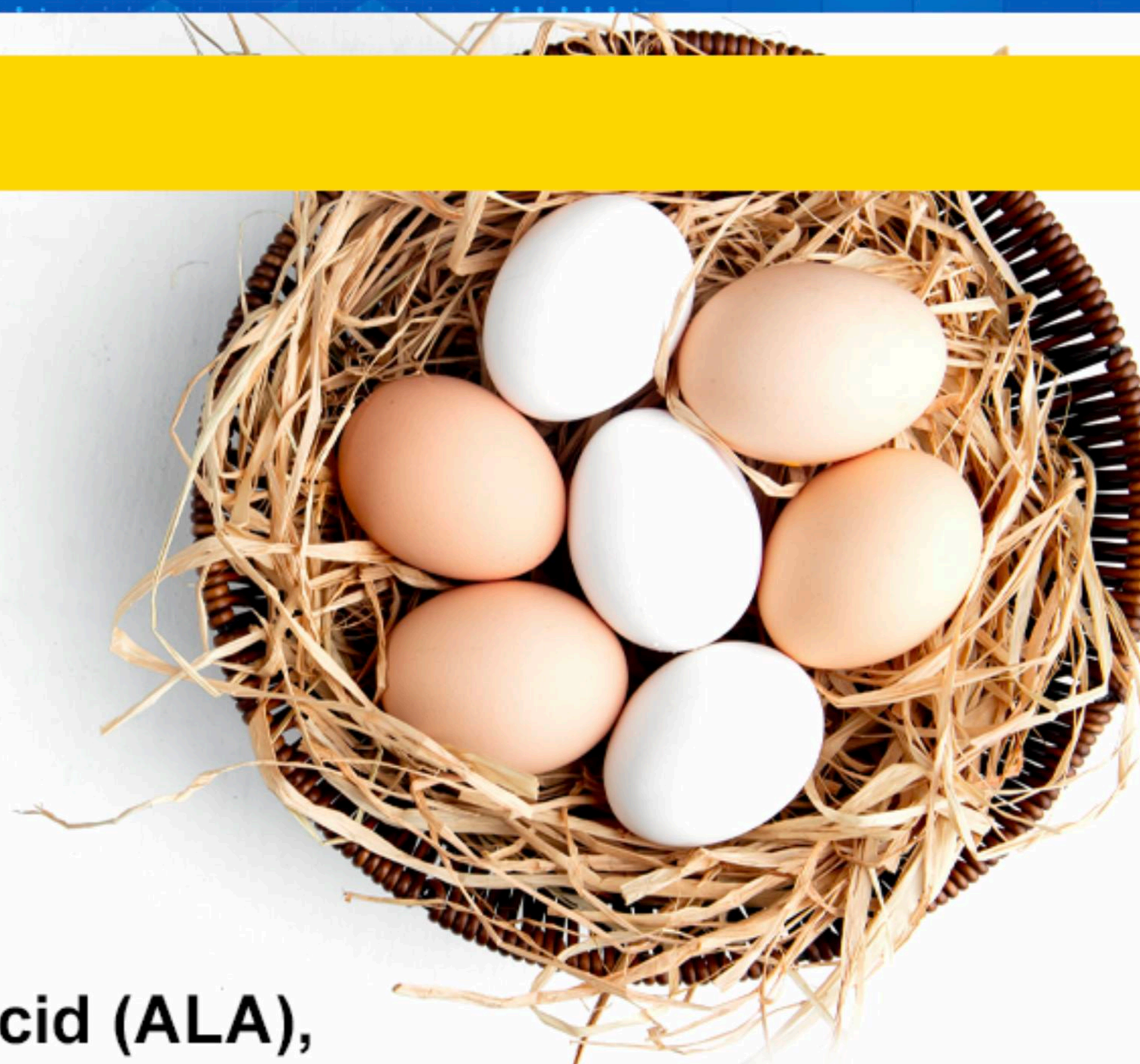
Egg yolk (%) 31.0

Egg white (%) 58.5

Energy (kcal / 100 g) 162

Protein (g) 12.1

- Omega-3 in yolk consists of alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA).
- The EPA and DHA - decrease the risk of cardiovascular, nervous system, mental disorders, inflammatory reactions, and prevent from chronic diseases.
- DHA is more effective to prevent the cardiovascular risk and used to developing brain tissue, retina, and nervous in embryo and children.



## Designer eggs - dietary manipulation

### ► Egg yolk - Fatty acids

Fish oil - 0.3 to 1.5% combined with soybean oil (from 3.5 to 4.7%) in laying hens diets resulted in the EPA content increase from **1.08 to 1.96**, DHA from **1.43 to 2.24**.

## Omega-3 Fatty acids enrichment

- ▶ Hen's diet rich in flaxseeds or linseeds - egg yolk is enriched with linolenic acid
- ▶ Diets containing **3 to 4 % fish oil** resulted in about **180 to 250 mg** DHA/egg, but the transfer efficiency decreased with the increase of addition level.
- ▶ Fish oil supplementation resulted in the highest DHA content as compared to flax seed / oil.
- ▶ **Designer eggs can supply about 50% of the daily requirement of n-3 PUFA.**
- ▶ n-3 fatty acid enriched eggs will undergo rancidity quickly
  - incorporate anti-oxidants in the hens' diet and extend the shelf life of the product.

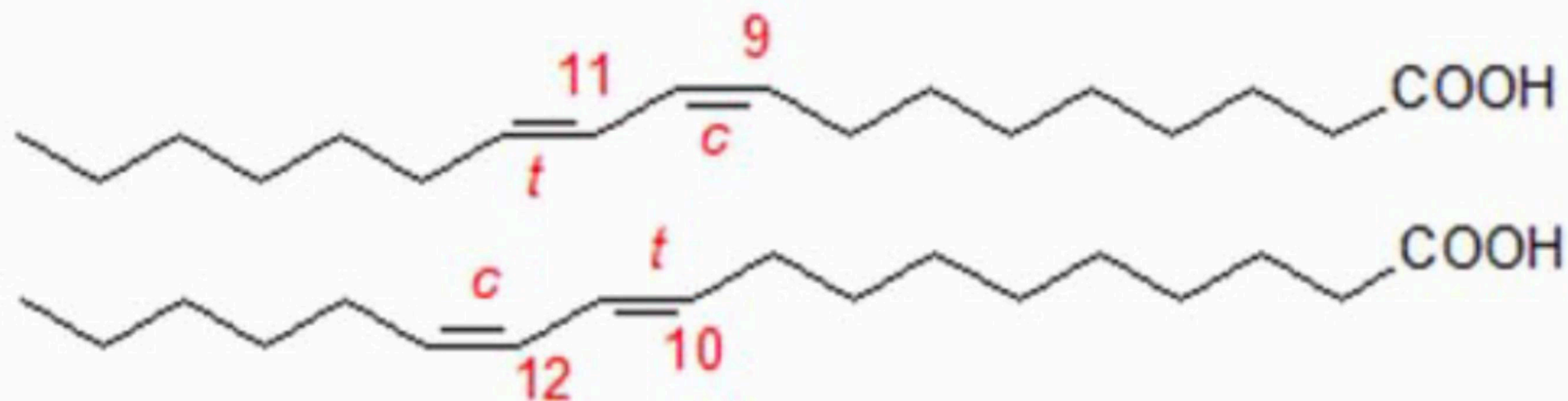
## Comparison of Types of Fat Constituents Found in Generic and Designer Eggs

PARAMETERS	GENERIC EGG	DESIGNER EGG
Total fat(g)	4.5	4.5
Saturated fat(g)	1.5	1.5
Linolenic acid (mg)	17	1000
DHA(mg)	18	100-150
Total omega -3 (mg)	33	100-150
Linoleic acid(mg)	500	100
Cholesterol (mg)	213	213
Vit. E (IU)	1.1	6.0

## Ways to produce designer eggs

### Conjugated linoleic acid - CLA

- ▶ CLA - beneficial to human health - antiobesity, antidiabetic, anticancer, antiatherogenic, and immunity improvement.
- ▶ Synthetic CLA in laying hen diets to produce eggs enriched with CLA has become a common practice in the table egg industry.
- ▶ Conjugated linoleic acid levels in egg yolks increase in a dose-dependent manner with dietary CLA addition. When dietary CLA was added at more than 5.0%, the content of CLA in the yolk would reach a plateau. Dietary CLA supplementation was also observed to increase the firmness and height of egg yolk.





## Ways to produce designer eggs

### Yolk colour

- ▶ White to orange depending on the deposition of **xanthophylls** from the feed. Sources - corn gluten meal, alfalfa, marigold, peppers and spirulina.
- ▶ High intake of carotenoids reduced the macular degeneration, a major cause of blindness in the elderly. **Lutein** safeguards the retina.
- ▶ Feed fortification with natural sources such as marigold, alfalfa extracts are sources of **lutein**.
- ▶ Other sources - corn and red pepper provide zeaxanthin and capsanthin respectively.
- ▶ **Lycopene** is a hydrocarbon carotenoid reported to have strong antioxidant properties effective in reducing the risk of prostate carcinoma.
- ▶ Lycopene enrichment - feed fortification with tomato powder

## Ways to produce designer eggs

### Lutein

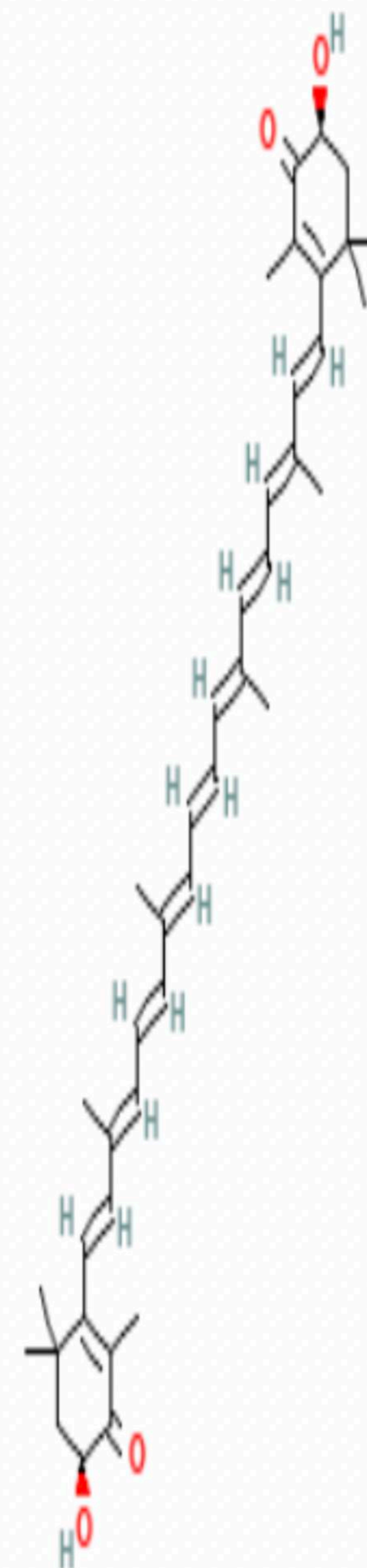
- ▶ Marigold flower extract is a suitable alternative to commercial synthetic carotenoids.
- ▶ Adding 1000 mg/kg lutein in layer feed can increase lutein concentration in their eggs up to 10 times.
- ▶ Enrichment of eggs with lutein was achieved by supplementing 2 g marigold per kg of feed.



## Ways to produce designer eggs

### Egg yolk – Fatty acids

- ▶ Fish oil share increase from 0.3 to 1.5% combined with soybean oil (from 3.5 to 4.7%) in laying hens diets resulted in the EPA content increase from 1.08 to 1.96, DHA from 1.43 to 2.24 and  $\sum$  n-3 PUFA from 1.26 to 1.60 times.
- ▶ **Astaxanthin** effectively pigments the yolk and exhibits strong antioxidant activity, which is 10 times higher than  $\beta$ -carotene and 550 times higher than vitamin E.
- ▶ The natural sources of astaxanthin are algae, yeast, salmon, trout, krill, shrimp and crayfish.
- ▶ Enrichment of edible eggs with lycopene or astaxanthin - improve the colour of egg yolks, but also to improve their antioxidant composition and functional properties.



## Ways to produce designer eggs

### Low cholesterol

- ▶ High cholesterol content ( 200 mg per egg) - major constraint for egg consumers. Chicken meat contains 60 mg per 100 g. Chromium, copper, nicotinic acid, statins, garlic, basil (tulasi), plant sterols, n-3 PUFA supplementation to chicken feed found to reduce the **yolk and carcass cholesterol levels** significantly.
- ▶ Difficult to decrease the cholesterol content of egg efficiently by alteration of the laying hens' diet. Maximum possible reduction is less than 10%.
- ▶ **Enrichment with Immuno-modulators**  
Omega - 3 fatty acids and anti-oxidants itself will increase the IgY level in the egg. Herbal supplementation will further boost the IgY level in the egg. Basil leaves (Tulasi) is having the highest ability to boost the IgY level in the egg. Other herbs like Rosemary, Turmeric, Garlic, Fenugreek, Spirulina, Aswagantha, also possess immuno-modulating properties.

## Ways to produce designer eggs

### Anti Oxidants in eggs and meat

- ▶ Egg is a rich source of natural antioxidants like vitamin-E, selenium, carotenoid pigments, flavonoid compounds, lecithin and phosphatin
- ▶ Herbal active principles - Allicin, Betaine, Eugenol, Lumiflavin, Lutein, Sulforaphane, Taurine, Lumichrome, Lycopene, Curcumin, Carnosine, Quercetin,
- ▶ Supplementation of these anti-oxidants in hens' diet will increase their levels in the egg and meat.
- ▶ Vitamin E and organic selenium are added as anti-oxidants at levels of 200-400 mg/kg and 0.1-0.3 ppm respectively.
- ▶ Lutein and Zeaxanthin are two significant anti-oxidants - prevention of macular degeneration and cataracts of the eyes.

## Ways to produce designer eggs

### Enrichment of eggs with vitamins and minerals

- ▶ Vitamin transfer efficiency
- ▶ Vitamin A (60-80%),
- ▶ Vitamin B12, riboflavin, biotin, folic acid and pantothenic acid (40-50%),
- ▶ Vitamin D3 and Vitamin E (15-25%).
- ▶ Niacin, thiamine, or pyridoxine - insensitive to dietary manipulation.
- ▶ Increase in dietary iodine, selenium, vitamins E, D and A is acknowledged to promote a more than 1.5-fold increase in yolk contents.
- ▶ Selenium, iodine, zinc, copper and chromium by dietary supplementation
- ▶ The egg zinc concentration of supplemented birds was elevated from  $33.36 \pm 0.89$  ppm (control group) to  $40.85 \pm 0.47$  ppm (supplemented group).

## Concentration of functional ingredients in eggs

- ▶ Omega-3 polyunsaturated fatty acids (% in total fatty acids) in yolk were 2.24 times higher
- ▶  $\alpha$ -linoleic acid -1.93 times
- ▶ EPA - 7 times
- ▶ DHA - 2.66 times
- ▶ Selenium ( $\mu\text{g/g}$ ) in yolk was 7.3 times higher, in albumen 4.63 times,
- ▶ Lutein in yolk ( $\mu\text{g/g}$ ) was 8.36 times higher and
- ▶ Vitamin E ( $\mu\text{g/g}$ ) in yolk was 1.58 times higher than in the control group.



Experts from Kerala Veterinary and Animal Sciences University discovered that the unusual incident of laying eggs with green colour yolk was due to the eating habits of the hens viz. feeding herbs and plants along with seeds

**Chromium** an antioxidant, it good for **type II diabetes** mellitus and protects the cells from free radicals thus preventing heart disease, cancer and it helps to boost the immune system.

The content of **selenium** in egg albumen was increased by 1.81 times, and in the yolk, it was increased by 1.18 times **Vitamin E** was 2.74 times higher, and **Lutein** was 8.94 times higher in enriched eggs than in conventional eggs.

### Designer meat

#### *Manipulation of fatty acid profile in meat*

- ▶ Feeding of fish oil / flax seeds
- ▶ Sea algae
- ▶ Enrichment with vitamin E, Se, Cr, carotenoids and conjugated linoleic acid (CLA).



## Points to be considered before enriching eggs

- ▶ Efficiency of nutrient transfer from feed to the egg.
- ▶ Commercial sources of effective feed forms of the nutrient
- ▶ Possible toxic effects of nutrients for the laying hens (Ex: Vitamin A and D are toxic for chickens at high levels)
- ▶ Amount of nutrient delivered with an egg in comparison with Recommended Dietary Allowance (RDA).
- ▶ Possible interactions with assimilation of other nutrients from the egg.
- ▶ Stability during cooking.

**Boost Your Immunity  
with Eggs**

contain  
**2%**  
daily requirement of Selenium  
needed for the proper  
functioning of the body &  
immune system.



www.ChickenInfo.org

\*Source- www.eggnutritioncenter.org



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*Thank you*