Designer egg and meat through nutrient manipulation

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Abstract

The health conscious consumers are demanding quality poultry products and ready to pay premium price. This leads to development in designer foods. The Designer foods are also termed as functional, fortified, enriched or nutraceutical value added foods. Designer foods have better potential effects on health besides providing the basic nutritional benefits. The designer eggs and meat are produced by nutritional manipulation of poultry diets i.e. addition of different health promoting components like antioxidants, minerals, omega fatty acids, vitamins, and various non-nutrient additives. The altered fatty acid profiles specifically the enrichment of egg and meat with omega 3 fatty acids, lowering of cholesterol and other compositional components such as choline, conjugated linoleic acid, lutein, selenium, and vitamins B, D, E and K, were produced recently. In this review, an attempt has been made to bring forth the different nutritional manipulations for production of designer poultry eggs and meat.

Keywords: Poultry, designer egg, designer meat, nutritional manipulations.

Introduction

Indian poultry industry is expanding very fast to meet the increasing demand of the domestic consumers. The poultry eggs and meat are nutrient rich food and now regarded as an inexpensive, convenient and low calorie source of high quality protein with several other essential nutrients. However, the health conscious consumers demand for the wholesome, healthy and nutritious food products free from harmful residues. They are more interested and ready to pay for the products which are more beneficial, wholesome and health promoting in order to improve their well being. The poultry products like egg and meat have already gained a healthy image, so in order to curb the prevalence of chronic diseases and several attempts were made to modify the eggs and meat by adding ingredients which are beneficial for the health or by eliminating or reducing components that are harmful. This modification resulted in development of functional egg and meat.

Improving consumers' health and nutritional status by designing nutritional profile of poultry egg and meat through dietary approaches is relatively simple and economic. Nutritional diets of birds influence meat qualities in terms of nutritive value, acceptability, human health and processing. Eggs can be designed through dietary approaches either through supplementation of specific nutrients, or certain herbs or specific drugs that have functional and therapeutic properties. In case of poultry, there are two types of value addition of products:

- Pre-slaughter or pre-oviposition value addition i.e. value addition before the product is produced. Products like, designer / organic / functional eggs and meat will come under this category which are usually free from residues of pesticides, drugs and other harmful chemicals.
- Post-slaughter or post-oviposition value addition i.e. value addition after the product is produced.

These types of value addition can be done mostly by combination of managerial and nutritional manipulations.

Designer Eggs

Designer eggs are those specially produced eggs which are rich in additional nutrients and health promoting components like carotenoids, chelated minerals, EPA and DHA like omega 3 fatty acids,
selenium, vitamin E and other immune-modulating factors. Designer eggs contain 600 mg of omega-3 fatty acids, equivalent to a 100 g serving of fish. Omega-3 fatty acids help in lowering dietary cholesterol content in the diet (Tur et al., 2012). Vitamin E, a fat soluble vitamin as well as an effective antioxidant, is enhanced to 100 per cent in these eggs. These eggs prevent cancer causing factors, cardiovascular diseases (CVD), and improve immunity and overall health status. Studies have shown that when 2-3 designer eggs are consumed every day, 100 per cent of the daily requirement of essential fatty acids is met (Fraeye et al., 2012; Tur et al., 2012). High-density lipoprotein (HDL) levels are raised while low-density lipoprotein (LDL) levels are decreased, blood fats are reduced, and more than 60 per cent of the daily vitamin E requirement is fulfilled. That’s why designer eggs are sold at a premium price and have a better consumer preference than the regular eggs.

In the late 80s, Sim, Jiang and their associates worked together to produce nutrient enriched eggs and developed designer egg, rich in n-3 fatty acids with antioxidants and patented this egg as ‘Professor Sim's Designer Egg’. Later in 1997, Van Elswyk developed eggs enriched with conjugated linoleic acid (CLA). In Australia, Farell (1998) enriched the eggs with folic acid and iron. Other available designer eggs in the market include eggs enriched with vitamins (Michella and Slaugh, 2000). In Canada, Leeson and Caston, (2004) produced lutein and selenium enriched eggs which help in preventing eye disorders. In India, Narahari (2005) has also developed Herbal Enriched Designer Eggs (HEDE), which is not only rich in carotenoids, n-3 PUFA, selenium, trace minerals and vitamin E, but also rich in herbal active principles like Allicin, Betaine, Euginol, Lumichrome, Luminflavin, , Lutein, Sulforaphane, Taurine and many other active principles of herbs, supplemented in the diets of hens. These eggs also contain natural sterols (phytosterols) like β-sitosterol, Brassicasterol, Campesterol, Stigmastanol etc. which are cardiac friendly in nature. The nutrient contents of designer eggs are comparatively higher than ordinary eggs as shown in Table 1.

**Designer meat and its products**

There is growing public concern towards coronary heart disease and artherosclerosis with the consumption of poultry meat due to having more cholesterol and saturated fatty acids. Chicken meat is relatively low in fat and cholesterol, thus considered healthier than other animal protein sources. Numerous dietary factors have tried to alter the fat deposition and cholesterol contents in the meat. Supplementation of copper, garlic, and omega-3 fatty acids has been used successfully to reduce the cholesterol content of the poultry meat (Esenbuğa et al., 2013). Manipulating amino acid concentration and calorie to protein ratio in the diet can enhance the protein and moisture concentration of the breast and thigh muscles. The main sources of PUFA are fish oil, linseed, millets and sea algae. The best ratio of omega 6 to omega 3 from a human health aspect was detected by the supplementation of linseed oil and cod liver oil (Bartos et al., 2004).

Givens and Gibbs (2006) have suggested that enrichment of meat products with ω-3 and its addition to animal feed to boost levels in animal-derived produce could play a major role bridging the gap between recommended and actual intake in human diets. When poultry meat is enriched with ω-3 fatty acids and selenium, 100 g of enriched tissue meets 70–130% and 30–60% of the recommended daily intake for humans respectively (Grashorn, 2007). Some studies have shown that conjugated linoleic acids (CLA) can reduce the risk of cardiac disorders and cancer causing problems (Dhiman, 2000), but CLA enrichment makes the meat tough affecting the meat quality. With ω-3 enrichment, poultry meat could contribute to dietary intake of about 75.0 mg ω-3 per person per day (Russell and Bürgin-Maunder, 2012).

**Manipulation of fatty acid profile in eggs**

The incorporation of ω-3 PUFA into eggs has been used by scientists to alter ω-6: ω-3 ratio towards the desired dietary ratio. Fatty acid composition of regular eggs and ω-3 PUFA enriched eggs are presented in Table 2. As an important part of the diet, the omega 6 to omega 3 ratios in the chicken egg has increased dramatically, from 1.3 under absolutely natural conditions to 19.4 under a standard United States Department of Agriculture (USDA) diet (Simopoulos, 2000). Since the ratio between omega-6 and omega-3 in eggs can easily be manipulated through diet enrichment, development of omega-3-enriched eggs can contribute to an improved balance between omega-6 and omega-3 in the human diet.

Sources of ω-3 PUFA such as fish oils (Shimizu et al., 2001), fish meal (Nash et al., 1995; 1996), marine algae (Herber and Van Elswyk, 1996) or a combination of several of the above (Baucells et al., 2000) can be used as supplements in layer diets. However, supplementation with fishmeal or fish oil can exert a negative influence on the sensory properties of the egg (Nash et al., 1996).
Table 1: Nutrient content of ordinary and designer/functional eggs

<table>
<thead>
<tr>
<th>Nutrient content</th>
<th>Quantity per 100 g of egg contents (2 eggs)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ordinary egg</td>
</tr>
<tr>
<td>Total saturated fatty acids</td>
<td>3.3g</td>
</tr>
<tr>
<td>Total unsaturated fatty acids</td>
<td>6.4g</td>
</tr>
<tr>
<td>Mono unsaturated fatty acids (MUFA)</td>
<td>4.4g</td>
</tr>
<tr>
<td>Poly unsaturated fatty acids (PUFA)</td>
<td>2.0g</td>
</tr>
<tr>
<td>Linoleic acid (ω-6 fatty acids)</td>
<td>1.9g</td>
</tr>
<tr>
<td>α-linolenic acid(ω-3 fatty acids)</td>
<td>0.03g</td>
</tr>
<tr>
<td>ω-3 fatty acid (EPA+DHA)</td>
<td>0.08g</td>
</tr>
<tr>
<td>n6/n3 ratio</td>
<td>17.3</td>
</tr>
<tr>
<td>Unsaturated/saturated fatty acids</td>
<td>1.94</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>400mg</td>
</tr>
<tr>
<td>Carotenoids</td>
<td>1.5mg</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>2mg</td>
</tr>
<tr>
<td>Selenium</td>
<td>Traces</td>
</tr>
<tr>
<td>Chromium</td>
<td>Traces</td>
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*Quantities depend upon their levels in the feed provided (Narahari, 2005)

ω-3 (Omega-3 Fatty Acids) enrichment

The omega-3 fatty acids, also called as n-3 fatty acids are a family of polyunsaturated fatty acids which have the first C-C double bond at the third carbon position counting from the omega end of the carbon chain. Important omega-3 fatty acids are derived largely as docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) from fish oils and as α-linolenic acid (LNA) from plant oil. Omega-3 fatty acids are usually obtained from two sources which can be classified as:

- The marine type ω-3 PUFA, DHA and EPA which are more commonly found in deep sea cold water fish (such as salmon, mackerel, herring, tuna, bluefish and anchovies), fish oil and marine algae. Marine algae are an efficient dietary alternative to other n-3 fatty acid sources. Yongmanitchai and Ward (1989) reported that some marine microorganisms synthesize significant amounts of long-chain fatty acids, particularly DHA and EPA. A Schizochytrium sp. has been used commercially as an alternative source of omega-3 fatty acids (Barclay et al., 1998). Herber and Van Elswyk (1996) found that marine algae contain about 11.2% long-chain n-3 on a dry matter basis. Comparatively, PUFA of marine algal origin are more stable and active in form than that of terrestrial plant origin. It was also found that the presence of marine algae carotenoids may enhance the oxidative stability of n-3 fatty acid enriched eggs.

- The terrestrial type ω-3 PUFA, LNA found in canola oil, soybean oil, flaxseed, walnuts, and spinach and mustard greens. As omega-3 fatty acid dietary sources, flaxseed oil is widely used in poultry egg and meat enrichment, due to its high content of LNA (50 to 60%) (Plourde and Cunnane, 2007) but flaxseed reduces the availability of minerals and also inhibits the activity of proteolytic enzymes (Ravidran et al., 1995).

A protective role of n-3 fatty acids against coronary heart disease (CHD) was firstly proposed by Dyerberg and Bang (1979). Dietary recommendations have been made for ω-3 fatty acids, including LNA, EPA and DHA to achieve nutrient adequacy and to prevent and treat cardiovascular disease. The ω-3 fatty acid recommendation to achieve nutritional adequacy is 0.6–1.2% of energy for LNA; up to 10% of this can be provided by EPA or DHA. A dietary level of 500 mg/d of EPA and DHA is recommended for cardiovascular disease risk reduction (Gebauer et al., 2006) and for treatment of existing CVD, 1 g/d is recommended and these recommendations have been followed by many health agencies worldwide. Omega-3 (ω-3) eggs are the first product produced by manipulation of egg composition, and enrichment with choline, conjugated linoleic acid, lutein, selenium, vitamins B, D, E and K, and has also attracted substantial attention in relation to egg and meat quality.
In designer eggs the n-6: n-3 PUFA ratio is decreased to about 1.5, from as much as 20 in regular eggs. This favourable change in designer eggs, will supply about 50% of the daily requirement of n-3 PUFA to the consumers, without any change in the sensory quality of the egg. This n-3 PUFA in egg yolk has decreased the serum triglycerides and increased the serum HDL-Cholesterol levels in human volunteers, when consumed for a period of two months at two eggs per day. Since the n-3 PUFA will undergo rancidity quickly, it is essential to prevent the rancidity of the designer egg yolk lipids, by incorporating anti-oxidants in the hens’ diet.

**Manipulation of fatty acid profile in meat**

The fatty acid composition of the n-3 rich PUFA source depends on its origin and oxidative status. Therefore, the dose of each n-3 rich PUFA source added to the feed impacts the fatty acid composition of meat and eggs differently, although there are some general recommendations. Zuidhof et al. (2009) have suggested that feeding flaxseed for 24 days before processing gave optimal breast meat ω-3 enrichment, carcass weight and meat yield. Betti et al. (2009b) reported that the duration of feeding flaxseed negatively affected the colour characteristics, functional properties, and oxidative stability of broiler meat and suggested a restriction on the duration of feeding to lessen the problem. More than 95% of ω-3 PUFA enrichment is due to LNA which is mainly deposited in the tri acyl glycerol (TAG) fraction of both breast and thigh meat (Betti et al., 2009a).

Addition of fish oil at 1.5% in the diet, acts as a good source of n-3 fatty acids (Basmacoglu et al., 2003). Rymer et al. (2010) have reported that algal biomass is as effective as fish oil at enriching broiler diets with fish oil with significant difference on the oxidative stability of the meat produced.

**CLA enrichment**

Conjugated linoleic acid (CLA) is a group of positional and geometrical isomers of 18-carbon unsaturated fatty acids with two conjugated double bonds (unlike linoleic acid, which has a nonconjugated diene). The most commonly occurring CLA isomers in synthetic mixtures are cis-9, trans-11-CLA and trans-10, cis-12-CLA, with minor amounts of trans-8, cis-10-CLA and cis-11, trans-13-CLA, which are indicative of more severe heating conditions during the synthesis of CLA from linoleic acid (Zhang et al., 2010). CLAs have been shown to have anticarcinogenic, antiadipogenic, anti-diabetic and anti-inflammatory properties (Wahle et al., 2004; Bhattacharya et al., 2006). Several studies have shown that concentrations of CLA in yolk lipids increased linearly as dietary CLA increased. Eggs produced by hens when fed with 5.0% CLA will contain 310 to 1000 mg of CLA per egg (Chamruspollert and Sell, 1999; Sukombat et al., 2006) which could provide a substantial amount of CLA in human foods to meet the proposed CLA requirement. Despite all the beneficial effects of CLA enrichment, it affects the texture and juiciness of the meat by making it tough and dark.

**Vitamin E enrichment in Eggs**

As ω-3 fatty acid enriched eggs are more susceptible to lipid oxidation, supplementation with vitamin E is generally recommended to stabilize egg lipids against rancidity and extend the shelf life of the product (Galobart et al., 2001b). Later Galobart et al. (2001a) found that supplementation of dietary vitamin E does not have a significant effect on daily feed intake, feed efficiency, egg weight and laying rate. Puthpongsiriporn et al. (2001) and Panda et al. (2011) reported that supplementation of vitamin E in layer diets enhance egg production and increase antioxidant properties of egg yolks and plasma of White Leghorn hens during heat stress. There is an improved feed intake, egg production, vitelline membrane strength (VMS), albumen and yolk height and foam stability (Kirunda et al., 2001) in heat stressed hens when fed with vitamin E supplemented diet (60 IU vitamin E/kg feed). Kucuk et al. (2003) have noticed that dietary vitamin E improved laying hen performance significantly in a cold environment, including feed conversion rate, body weight and egg production. Leeson et al. (1998) reported a decline in egg yolk flavour and overall egg acceptability when a higher level of vitamin E (100 ppm vs. 10 ppm) was used along with 20% dietary flaxseed. Leeson et al. (1998) recommended that the level of dietary vitamin E in

<table>
<thead>
<tr>
<th>Egg types</th>
<th>C 16:0</th>
<th>C 18:0</th>
<th>C 18:1</th>
<th>C 18:2</th>
<th>C 18:3</th>
<th>C 20:4</th>
<th>C 20:5</th>
<th>C 22:5</th>
<th>C 22:6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>21.50</td>
<td>8.00</td>
<td>42.10</td>
<td>13.80</td>
<td>0.22</td>
<td>1.75</td>
<td>---</td>
<td>0.15</td>
<td>0.08</td>
</tr>
<tr>
<td>Designer</td>
<td>16.90</td>
<td>6.20</td>
<td>41.70</td>
<td>13.70</td>
<td>4.58</td>
<td>---</td>
<td>0.73</td>
<td>0.89</td>
<td>5.83</td>
</tr>
</tbody>
</table>

(Narahari, 2005).

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**Table 2: Fatty acid composition of regular eggs and ω-3 PUFA enriched eggs**
feed should be 100 IU/kg in commercial n-3 fatty acid egg production.

**Vitamin E enrichment in Meat**

Vitamin E was reported to improve phagocytic ability of the immune system (Boa-Ampson et al., 2000) in broilers. Konjufca et al. (2004) reported that supplemental α-tocopherol acetate enhances Fc-receptor-mediated macrophage phagocytic activity at early stages (up to 3 weeks) of broiler growth. Niu et al. (2009) observed that heat stress (23.9–38°C) severely reduced growth performance, feed intake, feed conversion and immune response of broilers, while dietary vitamin E supplementation improved the immune response of broilers under heat stress. Vitamin E was also reported to reduce the lipid oxidation (malondialdehyde concentration) in breast and thigh meats during refrigerated storage (Götti et al., 2007). For designer egg/meal production, Vitamin E at levels of 200-400mg/kg are supplemented in the diet.

**Selenium enrichment in Eggs**

Selenium (Se) is a necessary trace mineral in reducing the oxidative damage of cell membranes of animals and humans. Se is an essential part of a variety of selenoproteins, such as glutathione peroxidase (GSH-Px), and at least six forms of GSH-Px were reported; GSH-Px is involved in cellular antioxidant protection (Arthur, 1997). Inorganic sources (selenate and selenite) and organic sources of selenium supplements (selenium yeast) are used in typical corn-soybean meal based layer diets to develop the Se enriched egg. Organic Se supplementation provides longer duration of freshness qualities of eggs (Wakebe, 1998) and it is used widely because its absorption is higher than that of the inorganic form (Payne et al., 2005). Inorganic Se has a lower transfer efficiency to eggs than the organic Se. Rutz et al. (2004) found that supplementation of organic Se to layer diets significantly improved egg production, egg weight, feed conversion ratio, albumen height, and specific gravity.

The use of Sel-Plex™, organic Se in the layer diet at 0.3 mg/kg resulted in significantly higher albumen values (Haugh Units) after seven days of storage. Se has a sparing effect on vitamin E, such that selenium supplementation can increase the vitamin E content of egg yolk (Surai et al., 2006). Sodium selenite and selenocysteine result in greater concentrations in the yolk. Selenomethionine results in greater deposition in the albumen (Latshaw, 1975). However, a high level of Se is toxic. Attia et al. (2004) found that the body weight, egg production, egg weight and feed conversion ratio decreased significantly at increased Se concentrations when chickens are fed at 0, 5 and 10 ppm Se in the basal diet. The maximum allowable level (0.3 ppm) used in commercial poultry diets is well below toxic levels.

**Selenium enrichment in Meat**

In several broiler performance trials, organic Se supplementation showed a positive effect on weight gain and FCR compared to controls (Spring, 2008). Birds supplemented with increasing levels of Se were better able to cope with the challenges of the reoviruses wasting disease. Several studies have also shown that supplementation with organic Se reduces drip loss in meat. Water holding capacity is also an important characteristic of meat, as it determines the level of exudative loss in packaging and during cooking, and the juiciness of meat. Organic Se exerts an antioxidant effect on the birds’ cellular membranes and tissue structures resulting in less exudative losses from meat (Pan et al., 2011). Organic Se (Selplex) at 0.1-0.3ppm can be added as anti-oxidants to the poultry diet (Surai et al., 2010).

**Roles of antioxidants in eggs and meat**

Poultry eggs and meat are rich sources of natural antioxidants like vitamin-E, Se, carotenoid pigments, flavinoid compounds, lecithin and phosvitin but at the same time, are highly susceptible to oxidative rancidity during storage. These antioxidants will protect the fat-soluble vitamins and other yolk lipids from oxidative rancidity. The designer eggs and meat, not only contain high levels of the above anti-oxidants but also contain synthetic anti-oxidant like Ethoxyquin and anti-oxidants of herbal origin such as Carnosine, Curcumin, Lycopene, Quercetin and Sulforaphene, depending upon the herbs used in the poultry diet (Narahari, 2005). Hence, supplementation of these anti-oxidants in the diet is essential to maintain the shelf life of the product.

Along with antioxidants like Vitamin E and Se, the enzymes like glutathione peroxidase, superoxide dismutase, catalase constitute an integral part of antioxidant cellular enzyme system in omega-3 enriched products to reduce lipid peroxidation. The dietary supplementation of vitamin E is commonly used in commercial n-3 enriched products to mitigate the oxidation of n-3 FA, thereby preventing the formation of undesirable fishy flavor and warmed over flavor in refrigerated cooked and raw meat (Fraeye et al., 2012). Besides these, other anti-oxidants as chemicals and herbs may be added, to prevent oxidative rancidity.
Advantages of antioxidant enrichment of poultry eggs and meat

- Reduce susceptibility to lipid peroxidation and rancidity.
- Prevent ‘fishy taint’ of the product.
- These could be a good source of antioxidants in human diet.
- Prevent destruction of fat-soluble vitamins and natural fat-soluble pigments.

Reduction in cholesterol content

A large egg contains about 213 mg of cholesterol per yolk (USDA, 1991) and chicken meat contains about 60 mg per 100 g. Yolk cholesterol content in omega-3-enriched eggs obtained from laying hens fed with 10% menhaden fish had 13.6% less yolk cholesterol than did the control eggs (Oh et al., 1991). Similarly, Scheideler and Froning (1996) fed birds with 1.5% menhaden fish oil or 5% whole or ground flaxseed-based diet, resulting in about a 9% yolk cholesterol reduction. Egg cholesterol levels are very difficult to influence by dietary manipulation, but some improvement has been reported from supplementing with copper (Pesti and Bakalli, 1998) and chromium (Lien et al., 1996). Several studies have indicated that supplementation with dietary micronutrients (copper, chromium, zinc, vanadium, and iodine) and/or dietary vitamins (vitamin A, ascorbic acid, and niacin) may change the yolk cholesterol level (Elkin, 2006). Enzymes have been reported to increase the percentage of egg albumen. Supplementation of natural products like garlic (Reddy et al., 1991), probiolic (Panda et al., 2003) and Lactobacillus acidophilus (Abdulrahim et al., 1996) in poultry feed help to reduce egg yolk cholesterol. It was reported that egg and plasma cholesterol levels were reduced by 23 and 22% respectively, through feeding dietary garlic powder (Mottaqihatabal and Taraz, 2002). Sim and Bragg (1977) investigated the effect of cholesterol metabolism by feeding plant sterols (phytosterols) to hens and reported a decrease of 16 to 33% cholesterol concentration in either plasma and egg yolk by feeding 2% dietary soysterols with either saturated or unsaturated oil, with or without cholesterol. Feeding dehydrated alfalfa free of choice also produce lean chicken breast meat as alfalfa is a good source of saponins which is hypocholesterolaemic in nature (Ponte et al., 2004). A reduction of serum cholesterol has been reported in broilers fed with Lactobacillus culture (Jin et al., 1998). Dietary supplementation of amino acids like glycine, lysine, methionine and tryptophan can decrease body fat deposition (Takahashi et al., 1994). The carcass and yolk cholesterol levels can be significantly reduced by supplementing herbal plants and products like basil (tulsi), bay leaves, citrus pulp (nirangenin), garlic, grape seed pulp guar gum, roselle seeds, spirulina, tomato pomace (lycopene), and many more herbs in chicken diets will reduce the chicken and yolk fat cholesterol levels by 10-25%. Canola oil, linseed oil, soybean oil and sunflower oil, reduced fat and cholesterol content in cockerel thigh and breast meat. Moreover, these substances act synergistically in reducing the cholesterol levels. Hence a combination of these supplements will be more beneficial, rather than a single substance.

Lean meat production

The present health conscious consumers prefer chicken meat with high protein, low fat and low cholesterol. In fact, chicken and yolk fats are not fats, but oil; because their saturated fatty acid content is only one third of the total fatty acid content, nearly 45% is cardiac friendly monounsaturated fatty acids (MUFA) and the remaining are polyunsaturated fatty acids (PUFA). By dietary manipulations, lean meat with low carcass fat (<5%) and cholesterol (<50mg/100g) can be easily produced. However, the cost of production of such lean meat will be higher due to lower body weight and poor feed efficiency. Addition of chromium (Cr) in feed shows a decrease in the fat content of the poultry meat (Toghyan et al., 2012). Cr enriched yeast at 1 g/kg diet showed an improvement in the carcass quality, whereas chromium picolinate at 0.5 ppm had significantly lowered the carcass fat level (Ibrahim et al., 2010). Organic Cr had increased the weight of pectoral muscles and the meat had less fat and cholesterol content. Cr supplementation (0.2 mg/kg) improved protein accretion and lowered fat deposition in meat (Amatya et al., 2004). Feeding of probiotics at 100 mg/kg diet improved moisture, protein, ash and decreased fat content in leg and breast meat of chicken (Khaksefidi and Rahimi, 2005). Narrowing the calorie:protein ratio, either by decreasing the energy level or increasing the protein level also helps in producing lean meat. Supplementation of fish oil to broiler diet at > 2% level will lower the cholesterol levels and abdominal fat pad thickness; but this feed manipulation is not recommended as it will impart an undesirable ‘fishy taint’ to the meat. An increase in the lysine level in the pre-starter diets and methionine level in the finisher diets will yield lean breast meat in broilers.

Conclusion

Poultry eggs and meat are a good source of essential nutrients. The development of nutrient
enriched value added poultry eggs and meat greatly increased the context of functional foods for human health. Hence, by manipulating the diet of chicken with the different available feed supplements in requisite amounts, value added and health promoting chicken egg, meat and their products, free from drugs, pesticide residues and other harmful toxic additives can be made available to the health conscious consumers. The designing must take into consideration the production facilities, available materials, technical know-how, economic resources of the producers and environmental impacts with welfare issues.

References

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