Non scientific restrictions to poultry production: main global myth and beliefs

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Introduction

There are some popular beliefs in commercial poultry production that always require justification. Certainly the first is the assumption by lay people that the rapid growth and precocity of broilers, as well as the high rate of egg production by the laying hens, must the result of exogenous hormones. Considering that even in the poultry business arena there are professionals whose technical background is not related to biology, we better start doing our home work making it clear about the truth. *Are there hormones involved in poultry production and is there a technical reason that would justify the use of exogenous hormones? Why do broilers grow so fast?*

Another area that affects us all is the relationship that has been assumed between egg consumption and the levels of cholesterol in blood, and thus related to cardiovascular disease problems. This has been a reason to keep even poor people away from egg consumption, besides being a low price and one of the most complete and nutritiously balanced foods. *What is true about this?*

Finally, and this is a more recent event, most of human nutritionists and health related professionals do recommend organic or any kind of alternative poultry product, arguing that these foods are both, healthier and more nutritious. *Is there any evidence in the literature that supports such believing?*

There are a great number of reviews in the literature in any of these themes, but in general they are addressed to technical specialists, thus containing details that make the comprehension difficult for lay people. This manuscript is an attempt to bring this issue to an easy understanding and help you to get answer for every-day ordinary questions.

Is there any advantage by using exogenous hormones in chickens?

The interaction of various endogenous and exogenous factors drives the way tissues grow and change the body weight of poultry. While nutrition and housing are important exogenous factors, the limit of the growth process is determined by the endogenous factors. Hormones are chemical substances secreted into organic fluids by the cells, with the function of drive the physiologic control at other cells or organs. These endogenous substances are essential components needed for the regulation, biosynthesis, and metabolism of muscle proteins.

Chemically, the most important hormones evaluated as possible growth enhancers are the sex steroids, thyroid hormones, and peptides from the somatotropic axis. Steroids have a chemical structure based on the sterol nucleus, similar to cholesterol and in general derived from it. In this group are the gonad hormones such as testosterone, progesterone, and estrogen. Thyroid hormones are tyrosine-derived (tiroxine, T4 and triodotiroxine, T3) while peptides are the somatotropic substances which considers the Growth Hormone (GH) and its related factors as the Insulin-like Growth Factors (IGF I and IGF II) and the Growth Hormone Releasing Factor (GHRF).

It is important to consider that amino acids, which are usually marketed for human consumption as a muscle propeller, are not hormones, but simple nutrients. Once ingested, they are absorbed in the intestine and, via blood flow, will reach a site where the nutrient role will be fulfilled. This is also the case of other substances such as vitamins and minerals. All these nutrients are also used in poultry nutrition.

Usually, when people hear how rapidly broiler chickens grow or how many eggs a layer produces, it is a general belief that something not legal, a "magic bullet", is being used. The major assumption is that some kind of exogenous hormones, besides the normal circulating endogenous substances, would be used. Although some efforts have been made to address this issue, as Penz (2012) in Brazil and Anderson & Gernat (2004) in the USA, in order to strengthen the discussion, we revisited the literature to review some studies, most realized in the eighties and nineties, which analyzed the technical possibilities of obtain advantages by the use of exogenous hormones.

Sex steroids

Studies evaluating the use of sex steroids in poultry are less frequent than in mammals and have met with much little success than those. In a study of Fennell & Scanes (1992), the utilization of three different androgens (testosterone, 5-dihydrotestosterone and 19-nortestosterone) implanted subcutaneously in leghorns (males, females, and castrated males) in general reduced body weight gain. There was no stimulus to growth of any of the substances evaluated. In fact as early as in 1948 it was observed that androgen, in both natural or synthetic forms, inhibits growth of broilers (Turner, 1948; Visco, 1973; Harvey & Scanes, 1978). What in fact happens with the use of androgens is a marked development of secondary male characteristics (Dube & Trembley, 1974; Fennel & Scanes, 1992).

Worries about supposed high ingested levels of steroid hormones through food are usually expressed on television by human nutritionists or even physicians. In order to evaluate the contribution of daily ingestion, a Germany team (Hartman *et al*., 1998) compared the secreted steroid hormones in humans to the estimated intake of these substances contained in food, based on a survey of the natural occurrence of steroid hormones in human nutrition. The intake of any of the hormones rarely reaches 6% of the naturally produced in the human body. When it comes specifically to meat (including chicken), which usually is the main concern, the authors concluded that:

> "*Meat does not play a dominant role in the daily intake of steroid hormones. More effects on human beings can be expected from exposure to phytoestrogens, which occur in plants in high amounts, or by environmental chemicals with hormonal or hormone blocking activity such as polychlorinated biphenyls or dioxines, which are widespread in food and water*" (Hartmann *et al*., 1998).

Therefore, it seems that many people are looking for the danger in the wrong place.

Growth Hormone

By far the focus of research related to poultry growth stimulus by hormones relied on studies evaluating the exogenous use of substances from the somatotropic axis. Growth hormone (GH) is required for normal posthatching growth, as lack of it resulting from hypophysectomy is followed by a dramatic decrease in the growth rate of chickens, whereas GH replacement restores growth to a great extent (King & Scanes, 1986). The somatotrophs are peptides, therefore cannot be used orally once would be degraded by gastrointestinal digestion. Furthermore, special attention to the injection or infusion procedure should be taken, since, according to the literature, it should be in pulsatile frequencies in order to mimic the natural process (Vasilatos-Younken *et al*., 1988). This by itself would implicate in application difficulties when we consider that billions of chickens are grown annually in Countries like the USA or Brazil. However, the main limitation is the lack of real performance advantage data that would justify the use of exogenous GH.

An interesting way to study the effect of different growth factors is using contrasting models like fast growth rate broiler chickens, light body weight gain pullets or dwarf chickens. Goodard *et al*., (1988) made such comparison with broilers and white leghorns based on plasma concentrations of IGF-I, GH, thyroid hormones and insulin. Interestingly, heaviest lines always have the lowest concentration of plasma GH. However, the negative relationship between growth rate and plasma GH concentration only occurs when fast-growing lines and slow-growing lines of poultry are compared, as observed for turkeys (Proudman & Wentworth, 1980), chickens (Burke & Marks, 1982; Goodard *et al*., 1988) and Japanese quail (Bacon *et al*., 1987). Such relationships get more complex when different genders are involved.

Growth control by hormones is not only dependent on interactions between hormones themselves but is totally dependent on the presence of receptors. These receptors occur on cell membranes, in the cytoplasm, and in the nuclei of the cells. It is known that there are slow growing dwarf chickens that lack the GH receptors (Burnside *et al*., 1992; Agarwal *et al*., 1994).

Studies with exogenous GH were performed using both natural or recombinant peptides. Initially, the evaluated GH usually was originated from bovine. According to Scanes *et al*., (1984), the effect of bovine GH on growth in intact broilers, turkeys, and ducks has been extensively studied, showing ineffectiveness to stimulate post hatching growth in poultry. Although it might indicate no activity of this hormone because of its bovine origin, previous studies related by the authors show activity of the bovine GH in hypophysectomised chickens.

The use of chicken GH of both from natural or recombinant origin in intact broiler chickens was evaluated by Cogburn *et al*., (1989). The substances were daily injected subcutaneously, for 14 days starting at 21 days o age, using doses of 100 or 200 μg/kg BW, the activity of the compounds being previously confirmed on essays with hypophysectomised rats. The study showed no effect on metabolic indicators (plasmatic levels of IGF-I, thyroid hormones, insulin, glucagon and glucose) and, although without effect on body weight, use of GH increased corporal fat. After exhaustive data analysis, the authors concluded that the "in vivo study clearly showed that daily injections of GH in broiler chickens has no benefic effect on body weight or on meat yield" (Cogburn *et al*., 1989). In a similar study, Burke *et al*., (1987) injected chicken recombinant GH (crGH) in a daily basis from 2 to 24 days of age. No effect on body weight was observed leading the authors to conclude that "several lines of evidence in this study indicate that rcGH is biologically active in chickens, but it clearly does not promote growth in normal, rapidly growing broilers". Vasilatos-Younken *et al*., (1988), working with 8-week-old broiler-strain pullets, injected cGH, but in a 90-minute interval for 21 consecutive days. The authors observed significant positive effect on feed efficiency, bone longitudinal growth and weight, and fat reductionAnyway, according to Vasilatos-Younken *et al*., (1999), based on own data and on a extend review, "in general, exogenous GH administration using both recombinant and pituitary-derived homologous preparations, have failed to improve somatic growth, and, in particular, skeletal muscle deposition, in pituitary-intact domestic poultry". The same authors reported a study with different recombinant chicken GH (cGH) administration to female-strain chickens at late post-hatch age (8 to 9 weeks, when endogenous GH secretion is relatively low). Each dose was delivered daily by intravenous infusion in 16 pulses to mimic the normal endogenous pattern. The conclusion of Vasilatos-Younken *et al*., (1999) was that,

> *"in contrast to the positive effects of exogenous GH on BW in mammals, cGH administered to late post-hatch broiler-strain chickens reduced body weight gain in a dose-dependent manner, with a maximal depression (34%) at the highest dosage administered (200 μg/kg/day)".*

Attempts have also been made with other related factors of the somatotropic axis. Moellers & Cogburn (1994) evaluated pulsatile infusion of growth hormone-releasing factor (GRF), which is a secretagogue of GH, thus enhancing plasma GH levels. The study showed that GRF did not improve growth rate, feed efficiency or body composition of young chickens. Similar studies were conducted with IGF-I, whose synthesis and secretion is tightly coupled to the pulsatile pattern of circulating GH, showing that there is no growth-promoting effects on intact normal growing chickens (Buyse & Decuypere, 1999). There are several exhaustive reviews in this issue (McMurtry, *et al*., 1997; Vasilatos-Younken, 1999; Buyse & Decuypere, 1999; Scanes, 2009), all reaching similar conclusions about a possible effect on broiler posthach performance.

Considering that *in ovo* injection could be of practical importance in case of positive result, Dean *et al*., (1993) evaluated in ovo injection of bovine recombinant GH using chicken eggs at day 11 of incubation. After detailed BW and metabolic data analysis and discussion, the authors suggested that "GH is not directly involved in somatic growth of young rapidly growing chickens". Some years later, Kocamis *et al*., (1998) reported a study were *in ovo* injection of recombinant human IGF-I seemed to show some promise, what however has not been further explored.

Thyroid Hormones

The importance of the thyroid hormones on muscle development has been observed long ago through the induced hypothyroidism produced by injection of propylthioracil (King & King, 1973) or by physically thyroidectomizing the chickens (Moore *et al*., 1984). Muscle growth was influenced by severe hypothyroidism and was recovered to a normal level by the use of exogenous thyroid hormone (King & King, 1973). However, when evaluations were made on intact chickens, no improvement has been observed. In a study of May (1980), various essays were performed with broilers using exogenous T3 and T4. No improvements on BW or feed conversion rate were obtained, although some treatments resulted in high plasmatic level of the tested substances. The author, however, observed some growth stimulus of sex-linked dwarf chicks by the administration of

either T3 or T4. Interestingly, continuous exogenous use of T3 in broiler diet reduced growing of the chickens (Decuypere *et al*., 1987).

Why are exogenous hormones not used in chickens?

Here are the main reasons, already referred to before (Anderson & Gernat, 2004; Penz, 2012), we suggest that general poultry business related people should be sure about:

1. **It is illegal**. In most countries there is specific legislation.
2. **There is no technical reason:** research does not show advantages in performance of intact poultry, thus there would be no justification to use such substances in commercial production.
3. **Practical reason:** Depending on the substance, it should be injected individually or through catheter implantation be liberated at pulsatile frequencies in order to mimic the natural process. Considering that only in Brazil more than six billion broilers are produced annually, it seems really not a feasible procedure.
4. **Cost:** Substances like chicken GH are only available in order to attend low quantity demands of research laboratories. Therefore, these substances are of high cost, what would not be compatible with the low profit reality of the commercial poultry business. There is no high commercial production of these substances, nor is there demand for it.
5. **Finally,** it has to be considered that the poultry industry is highly professional, with quality requirements of the international market to be met. Therefore, it is an activity performed with zeal, the companies taking care of the respective brand. In the market, one, only one quality deviation may be enough to bring a long high-quality history down to almost nothing. There is no room for the use of questionable or illegal substances, like hormones, in this business.

What makes broilers grow so fast?

The high capacity of body weight gain we see in broilers is the result of decades of investments in scientific research generating great genetic impacts and improvements in the environmental areas (nutrition, health, housing and general management). As an example in the nutrition area, broilers consume a diet balanced considering the level of amino acids, macro- and micro-minerals and vitamins, besides satisfying the required energy. Therefore, commercial chickens receive the nutrients they need to express their genetic potential.

But it is in the genetic area where the greatest improvements have occurred. An interesting study that shows it was developed by Havenstein *et al*., (2003a,b) in North Carolina, which compared a broiler strain maintained nonselected to the genetically selected counterparty, both using the old 1957- and the new 2001-diet. There was some advantage by using the modern diet on the old strains (8.5% for BW, 10,1% for FCR, and no gain for breast yield), and a much better gain using the modern diet on the selected broilers (27.8% for BW, 16% for FCR, and 14.7% for breast yield). However, evaluating the advantage of the selected genetic strain over the unselected ones showed a much higher impact: gain of 320% for BW, 20% for FCR, and 60.1% for breast yield. Therefore, here is the "magic bullet" responsible for the fantastic development of broiler chickens. The authors concluded that "genetic selection brought about by commercial breeding companies responds for about 85 to 90% of the change that has occurred in broiler growth rate over the past 45 yr, while nutrition has provided 10 to 15% of the change" (Havenstein *et al*., 2003a).

Is there a relationship between dietary cholesterol and plasma cholesterol levels?

Eggs are a high nutritional-value food, able to provide most of our daily dietary requirements and functional factors. Furthermore, in the technological point of view, coagulating and emulsifying properties allow its remarkable use in the food industry. It is well known that the egg is an excellent source of digestible protein with balanced amino acid composition and antioxidant activity (Sakanaka *et al*., 2000, Sakanaka *et al*., 2004). Evaluating its contribution in the American diet, Song *et al*. (2000) found that daily nutrient intake,

except fiber and vitamin B6, was significantly higher in egg consumers than those subjects eating free-egg diets.

Nutraceutical factors also give eggs an important multifunctional role in human diet (Stadelman, 1999). For instance, egg yolk is a highly bioavailable source of lutein and zeaxanthin, which are carotenoids with pharmacological properties, mainly in the prevention of degenerative eye diseases (Handelman *et al*., 1988; Sommerburg, 1999; Miller *et al*., 1996; Ribaya-Mercado & Blumberg, 2004). According to Handelman *et al*., (1999), lutein and zeaxanthin levels in blood increase significantly after dietary supplementation with egg yolk.

However, despite such nutritional and functional quality, people have a negative concept regarding to egg consumption. It continues to be viewed as a "bad food" by the general population. The main reason is because of its high cholesterol content (around 200 mg in a medium-size egg), what generates restrictive recommendations of its inclusion in our regular diets, often associating it to incidence of coronary heart disease (CHD). It is usual to assume that cholesterol-rich foods, especially eggs, can raise blood cholesterol and thus increase the risk of heart disease. Recent findings do not support this hypothesis, and dietary guidelines are being revised concerning egg consumption in order to keep a good diet quality (Kritchevsky, 2004; Lee & Griffin, 2006; Gray & Griffin, 2009).

Cardiovascular problems in humans are in fact linked to dyslipidemia. Clearly, high levels of fats (triglycerides) and cholesterol in blood, as well as changes in distribution of low density lipoprotein cholesterol (LDL) and high density lipoprotein cholesterol (HDL) are independent risk factors associated to development of CHD (LaROSA *et al*., 1990; Artaud-Wild *et al*., 1993; Sharrett *et al*., 2001; D'Agostino *et al*., 2001; Santos Filho & Martinez, 2002). The CHD risk increases 27% in men and 34% in women with elevated total plasma cholesterol (≥ 200 mg/dl), as estimated by Wilson *et al*., (1998). For each unit elevation in plasma triglycerides, the meta-analysis carried out by Austin and co-workers (1998) showed that CHD risk increases 14% in men and 37% in women. On the other hand, Gordon *et al*., (1989) reported that 1 mg/dl increase in HDL cholesterol was associated with significant decrease in CHD risk (3.7% for men and 4.7% in women). Yet Manninen *et al*., (1992) used LDL/HDL ratio predictor of cardiac events. Subjects with LDL/HDL ratio >5 and triglycerides >202 mg/dl had relative risk of 3.8 higher than those with LDL/HDL ratio ≤5 and triglycerides ≤202 mg/dl. Similar results were observed by Assmann *et al*., (1998), who reported increase of 26.9% in CHD risk in individuals with combined LDL/HDL ratio >5 and hypertriglyceridaemia.

The effect of dietary cholesterol on changes of serum lipids and lipoproteins profile, and its relationship with CHD has been an issue of prospective investigation and several debates. Simple regression analysis of data from clinical and epidemiological surveys has shown positive correlation between cholesterol intake and both plasma cholesterol level (McNamara, 2000a) and CHD mortality (LaROSA *et al*., 1990; Artaud-Wild *et al*., 1993; Kromhout *et al*., 1995; McNamara, 2000b). But, with the current understanding, dietary cholesterol is not an independent variable influencing plasma cholesterol and lipoproteins. Multivariate analysis is the more appropriated in order to minimize confounding by other dietary factors (such as saturated fats, dietary fiber, polyunsaturated fats, and trans fat), avoiding wrong outcomes about relative risk of CHD.

Several cholesterol-rich foods are also a natural source of saturated fats (SFAs), which have a consistent positive correlation with levels of plasma cholesterol, lipoproteins, and CHD (Kromhout *et al*., 1995; Hu *et al*., 1997; Clarke *et al*., 1997; Howell *et al*., 1997; McNamara, 2000b). Isocaloric replacement of SFAs by carbohydrates for 10% of dietary calories results in blood total cholesterol dropping of 14-20 mg/dl (Mensink & Katan, 1992; Clarke *et al*., 1997; Mensink *et al*., 2003). According to Mensink *et al*., (2003), LDL and HDL levels fall about 1.24 and 0.39 mg/dl respectively when saturated fats constituting 1% of dietary energy are isoenergetically replaced by carbohydrates, resulting in a discrete effect on LDL/HDL ratio.

Data from epidemiologic surveys and controlled clinical trials have indicated that replacing saturated fat with unsaturated fat is more effective in lowering risk of CHD than simply reducing total fat consumption (Hu *et al*., 2001; Hu & Willett, 2002). Monounsaturated fats (MUFAs) and polyunsaturated fats (PUFAs) are inversely associated with serum lipids and lipoproteins, presenting a substantial benefit in attenuate CHD risk (Jakobsen *et al*., 2009). It is also known that MUFAs and PUFAs have biologically significant effects on levels of total cholesterol and LDL/HDL ratio. Predicted changes on lipids and lipoproteins profile as a consequence of dietary intervention are summarized on **Figure 1**, based on Mensink & Katan (1992) and Mensink *et al*., (2003). Using data from 27 trials, Mensink

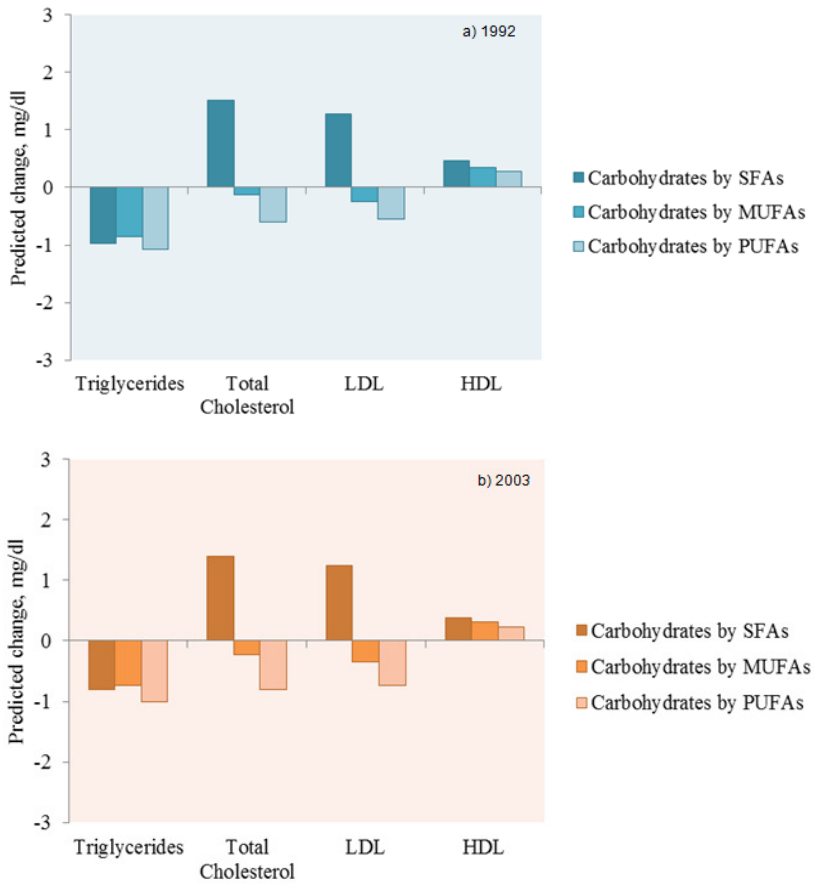

Figure 1 - Mean changes in levels of lipids and lipoproteins in blood when 1% of dietary energy from carbohydrates is replaced isoenergetically with different types of fats. (LDL: Low density lipoprotein cholesterol; HDL: high density lipoprotein cholesterol; SFA: saturated fatty acids; MUFAs: monounsaturated fatty acids; PUFAs: polyunsaturated fatty acids). Source: Adaptated from a) Mensink and Katan (1992) and b) Mensink *et al*.,(2003).

and Katan (1992) estimated that direct isocaloric replacement of SFAs by PUFAs lead to a fall in total cholesterol of 2.1 mg/dl and LDL cholesterol of 1.8 mg/dl per percent of energy. These results were confirmed by Mensink *et al*., (2003) evaluating data from 60 controlled trials (total cholesterol decrease about 2.2 mg/dl and LDL cholesterol falling by 1.97 mg/dl per percent of energy). According to Clarke *et al*., (1997), total cholesterol decreases about 15 mg/dl by direct replacement of 5% of energy as SFAs by PUFAs, and 9 mg/dl changing 5% calories as SFAs by MUFAs. Hu and co-workers (1997) reported that each increase of 5% of energy intake from saturated fats, as compared with equivalent energy from carbohydrates, was associated with a 17% increase in the CHD risk in women. In the same publication, the authors estimated that direct replacement of 5% of calories from saturated fats by unsaturated fats would reduce risk in 42%.

Diets characterized by a pattern high in fats and cholesterol (from animal products) are frequently poor in cereals, vegetables, and fruits, leading to a low level of dietary fiber. This is an important point since most of epidemiological studies suggest inverse relationship between dietary fiber and CHD. Brown *et al*., (1999) quantified cholesterol-lowering effect of major dietary fibers, observing that soluble fiber (2-10 g/day) was associated with discrete but significant reduction in plasma total cholesterol (-1.7 mg/dl/g soluble fiber) and LDL cholesterol (-2.2 mg/dl/g soluble fiber). According to Pereira *et al*., (2004), each 10 g/day increment in total dietary fiber decreases by 14% the risk of all coronary events and by 27% the risk of coronary death. As reported by Dauchet, *et al*., 2006, CHD risk was reduced by 4% for each additional daily portion of fruit and vegetable intake and by 7% for fruit intake. In overall, it is more important to control intakes of saturated and *trans* fats as well as to increase consumption of vegetables, fruits, and foods rich in unsaturated fats to prevent coronary and arterial events, as stated by Hu & Willet, 2002):

> *"Compelling evidence from metabolic studies, epidemiologic investigations, and clinical trials in the past several decades converges to indicate that at least 3 dietary strategies are effective in preventing CHD: substitute unsaturated fats (especially polyunsaturated fat) for saturated and trans-fats; increase consumption of omega-3 fatty acids from fish oil or plant sources; and consume a diet high in fruits, vegetables, nuts, and whole grains and low in refined grains. A combination of these approaches can confer greater benefits than a single approach. However, simply lowering the percentage of energy from total fat in the diet is unlikely to improve lipid profile or reduce CHD incidence." (Hu & Willett, 2002).*

Since interaction among different factors must be taken into account, publications considering the set of dietary features have demonstrated the realistic effects on plasma cholesterol levels and CHD risk. When multivariate analysis include saturated fats and fiber intake, dietary cholesterol (also from egg) has a slight influence on levels of blood cholesterol, LDL, and HDL. As summarized in **Figure 2**, predictions are able to shown that a 100 mg/day change in dietary cholesterol only increases, on average, plasma total cholesterol by 2.2-2.7 mg/dl, LDL cholesterol by 1.9 mg/dl, and HDL by 0.4 mg/dl (McNamara, 1995; McNamara, 2000a; McNamara 2000b). Furthermore, it is important to observe the considerable heterogeneity degree between individuals. Majority (75-85%) of individuals are classified as hypo-responders (plasma cholesterol varies by 1.4 mg/dl per 100 mg/day change in dietary cholesterol), and minority exhibit hyper-responder behavior (plasma cholesterol varies by 3.9 mg/dl per 100 mg/day change in dietary cholesterol) (McNamara, 2000a; Fernandez, 2010).

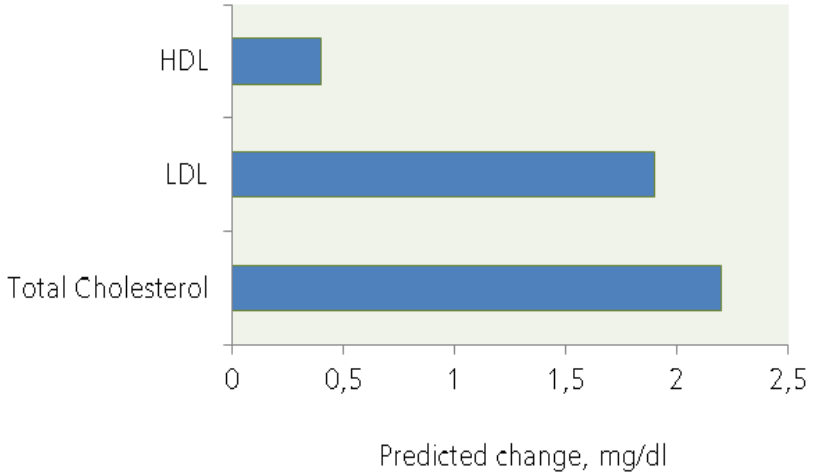

Figure 2 - Changes in levels of total cholesterol and lipoproteins in blood following increase of dietary cholesterol by 100 mg/day. (LDL: Low density lipoprotein cholesterol; HDL: high density lipoprotein cholesterol). Source: Adaptated from McNamara (2000a).

Based on all evidences, it is convenient to accept that dietary cholesterol has a modest effect in changing the level of circulating cholesterol and lipoproteins of non-diabetic population (McNamara, 2000a; Kritchevsky & Kritchevsky, 2000). Overall, in order to prevent coronary events, it is more important to control the intake of saturated and trans fats as well as increase vegetables and fruits consumption. Eggs, which are a nutritive food with relative low levels of SFAs (1.6 g in a medium-size egg), are not significantly associated with hypercholesterolemia or even cardiovascular disease incidence. Its moderate consumption should be permanently encouraged as part of a healthy diet, as stated by McNamara (2000a) and Gray & Griffin (2009):

> *"Recommendations that egg consumption be restricted by the general population are not supported by the experimental data and, as noted by the reviews published in this issue of the journal, limit a valuable and affordable source of high quality nutrition from the diet. The nutrient density of eggs and their role in a heart healthy diet need to be reconsidered in light of the changing dietary patterns in the population and the increase in obesity in the American public. There is no scientific justification for population-wide specific limits on weekly egg consumption, and such restrictions only serve to divert attention away from effective dietary and life-style interventions to lower CHD risk." (McNamara, 2000a).*

> *"The egg is a nutrient-dense food, a valuable source of high quality protein and essential micronutrients that is not high in SFA or in energy. In the current difficult financial climate, eggs can play a useful role as a relatively inexpensive source of nutrition for all and especially for people on low incomes." (Gray & Griffin, 2009).*

Are there advantages of organic over the conventional poultry products?

The main reasons people prefer alternative products, especially organic food, over the conventional is because they believe there is a nutritious advantage, that they are healthier, or because it fits better in their lifestyle. There is not much to discuss on the last item, or even on a fourth one which would be related to taste, but we shall address the nutritious and health issue.

A study of the UK Food Standard Agency observed that the nutrient levels in foods vary depending on many different factors. These include freshness, storage conditions, crop variety, soil conditions, weather conditions and how animals are fed. All crops and animals therefore vary in nutrient level to some extent. The available evidence shows that the nutrient levels and the degree of variation are similar in food produced by both organic and conventional agriculture. All processed food, including organic, has a nutrient content that is dependent on the nutrient content of ingoing ingredients, recipe and cooking methods. The impact of processing on nutrient levels will be the same for products made from organically and conventionally produced ingredients. In the same report the agency concludes that there is no scientific evidence that organic food is any different in nutrition composition or in safety than the conventional food. This study is supported by a systematic review on 52,471 articles which did not find any significant nutritional differences between conventional and organic foodstuffs (Dangour *et al*., 2009).

Another systematic review (Dangour *et al*., 2010), which considered 98,727 scientific articles, focused on 12 relevant studies about possible human benefits of organic food consumption. The conclusion was that evidence is lacking for nutrition-related health effects that result from the consumption of organically produced foodstuffs, with the exception of one report showing that strictly consumption of diary organic products was related to lower levels of eczema in infants.

It is also usual people relate organic products to lower hazards or even to risk free. So far, there is no support for such belief, a good contrary example being the outbreak of food contamination occurred Europe in 2011, which involved the consumption of bean sprouts from an organic farm in northern Germany. This wide known outbreak was caused by the *E coli* (Shiga toxin-producing O104:H4), resulted in thousands of humans infected and dozens of fatalities (Sample 2011; Werber *et al*., 2012).

The scientific community and governmental agencies have the duty of inform the consumers about the scientific findings about all different ways that food is produced and their real benefits or health risks. Paying more for an alternative produced food is a personal decision related to freedom of choice, which according the literature evidence, cannot be based on any nutritious or heath benefits.

Concluding remarks

It is our understanding that the consumption of poultry meat, as well as eggs, should be encouraged, considering it offers high quality nutrients at prices most of world population can afford. Concerning some myths, it is important to make clear that worldwide there is a sophisticated professional poultry industry which generates jobs, food and wealth, and does it with responsibility. Perhaps the industry itself should be more emphatic about showing the quality of its products. There are important initiatives going on in Associations and Institutes like the Brazilian Eggs Institute (Instituto Ovos Brasil). However, occasionally wrong marketing strategies come afloat from some industries worldwide. When a customer sees a label asserting that it is "produced without hormones", his reaction is that usually the products in the marked are loaded with hormones. Definitely, such marketing strategies do not help.

Finally, it seems appropriate to stress out the importance of science-based conclusions. According to Gleiser (2010), science offers the possibility of freedom from the unknown, the irrational. He states that by giving the autonomy to think by himself, science offers freedom through knowledge-based choices; and by transforming mystery into challenge science adds a new dimension to life, now free from dogmas.

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