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Producing specialist poultry products to meet human nutrition requirements: Selenium enriched eggs

V.I. FISININ[1], T.T. PAPAZYAN[2] and P.F. SURAI[3]*

[1]All-Russian Institute of Poultry Husbandry, Sergiev Posad, Russia; [2]Alltech Russia, Moscow, Russia; [3]Avian Science Research Centre, SAC, Auchincruive, Ayr, UK
***Corresponding author: psurai@alltech.com**

During the last decade it has become obvious that, while our lifestyle, including diet, stress, smoking, medical issues, exercise, and genetics are major determinants of human health status, it is diet that plays a central role. The effect of nutrition on human health has received substantial attention, and even 'traditional' medicinal philosophies that state that diet and nutrients play only limited roles in human health is being revised. In most developed countries nutritional practices have changed the focus from combating nutrient deficiencies to addressing nutrient requirements for maintaining good health throughout life. The role of selenium (Se) in human health and diseases has been discussed in detail in several recent reviews, with the main conclusion being that Se deficiency is recognised as a global problem which needs solving urgently. Analysing recent publications that relate human health to useful poultry products, it is evident that Se-enriched eggs can be used as an important delivery system of this trace mineral for humans. In particular, developments and commercialisation of organic forms of selenium has initiated a new era in the availability of selenium-enriched products. It has been shown that egg selenium content can be easily manipulated to give increased levels, especially when organic selenium is included in hen's diet at levels that provide 0.3-0.5 ppm Se in feed. As a result, technology for the production of eggs delivering ~50% (30-35 μg) of the human selenium RDA have been developed and successfully tested. Currently companies all over the world market Se-enriched eggs including the UK, Ireland, Malaysia, Thailand, Australia, Turkey, Russia and Ukraine. Prices for enriched eggs vary from country to country, typically being similar to free-range eggs. The scientific, technological and other advantages and limitations of producing designer/modified eggs as functional foods are discussed in this paper.

Keywords: selenium; eggs; human nutrition; functional foods

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Introduction

The relationship between diet and human health has received substantial attention in the last few years, with the realisation that unbalanced diets can cause serious health-related problems. However not everyone consumes the same food, and people meet their nutritional needs in many and varied ways. From the many food ingredients commonly present in our diet, natural antioxidants are considered particularly important. It is well known that free radicals produced under both normal physiological conditions and under stress conditions can have damaging effects on polyunsaturated fatty acids, DNA and proteins in the body. Antioxidant protection is vital for either prevention or substantial reductions in the damage caused by free radicals and products of their metabolism.

Food provides a major source of natural antioxidants for humans, including vitamin E, carotenoids, flavonoids and selenium (Se). Particular interest in Se has been generated as a result of clinical studies showing that dietary supplementation with organic selenium, in the form of yeast grown on a media enriched with this trace element, decreased cancer mortality 2-fold. Additionally, there is data indicating that inadequate selenium consumption is associated with poor health, genetic defects, decreased fertility and defence against various viral and bacterial diseases. Unfortunately, in many countries all over the world human food ingredients can contain inadequate levels of selenium, and Se deficiency in human nutrition is a global problem. As a result, finding solutions to this problem are now on the agenda of many government health bodies.

Results derived from various research studies conducted over the last few years have indicated that the Se-enrichment of animal-derived foods (mainly meat, milk and eggs) with selenium via supplementation of animal feeds can be an effective way of increasing human selenium status in countries where selenium consumption falls below the Recommended Daily Allowances (RDA), *e.g.* consumption in the UK is shown to be about 50% of RDA.

The role of providing Se in human health

There is a great body of evidence to show health-promoting properties of Se. Deficiency in the human population is associated with two diseases (Keshan disease and Kaschin-Beck disease) reported in areas of China and other countries characterised by extremely low Se content in soil and the food chain. In humans, Se deficiency is associated with a compromised immune system and increased susceptibility to various diseases, including arthritis, cancer, cardiovascular disease, cataracts, cholestasis, cystic fibrosis, diabetes, immunodeficiency, lymphoblastic anaemia, macular degeneration, muscular dystrophy, stroke and some others (Surai, 2006).

The most compelling evidence exists in relation to the cancer-protective effects of Se (Papp *et al*., 2007; Squires and Berry, 2006; Whanger, 2004). In epidemiological observations and prospective studies an inverse correlation between Se levels in food and blood and risk of cancer and cancer mortality were observed. There are also case-control studies showing that Se levels in blood, serum, hair or toenails are lower in cancer patients than in unaffected people. Thirdly, laboratory animal studies have shown a protective effect of various forms of Se against cancer initiation and development. Finally, there are human intervention trials showing Se supplementation to be an effective means of decreasing the risk of DNA damage associated with the development of cancer. So far there have been 10 human trials testing protective effects of Se against cancer, six of them conducted in China, a country characterised by a number of Se-deficient regions. The main outcome of the trials was a protective effect of Se (in most cases selenised-yeast) against cancer. Such data provided a strong incentive to design a definite trial for selenium and vitamin E with prostate cancer as a primary end point. Hence, there are new human trials underway to further substantiate the protective effects of Se against cancer, including a SELECT trial employing 32,000 participants without prior evidence of prostate cancer from more that 400 participating study sites in the USA, Puerto Rico and Canada. This trial will last for 12 years with a budget exceeding 200 million US$.

In aforementioned trials it has been shown that increasing Se consumption to provide concentrations in the blood exceeding 121 µg/l may address Se deficiencies and simultaneously provide some protection against cancer. It is not clear at present how this protective effect of increased Se concentrations in plasma occurs. In general, there are two approaches, nutritional and pharmacological, to achieve Se protective effects against cancer. The nutritional approach includes consumption of Se-enriched food, such as eggs, meat, milk as well as various vegetables. The pharmacological approach involves the consumption of Se-tablets in the form of sodium selenite, SeMet, various chemically synthesised organo-selenium compounds (Surai, 2006). It should be mentioned that increased Se-status will have not only cancer-protective effect, but also will help the body to fight other free radical-associated diseases.

Dietary deficiencies of selenium have been implicated in the aetiology of cardiovascular diseases (CVD). However, the results of longitudinal studies within populations conflict with investigations that have shown a relationship between low serum-selenium levels and the risk of coronary disease, while others did not. In general, dietary Se supplement may be considered anti-atherosclerotic. It has been shown that non-limiting selenium availability counteracts the post-prandial formation of the atherogenic form of LDL, and provides a rationale for the epidemiological evidence for the inverse correlation between selenium intake and the incidence of chronic and degenerative diseases (Natella *et al*., 2007). Furthermore, Se supplementation (200 ug/day as Se-yeast for a week) has been shown to improve blood fluidity, by metabolic modification of lipoproteins (Abdulah *et al*., 2006) which may provide an additional protective factor against CVD development. As such, dietary selenium supplementation may provide a safe and convenient method for increasing antioxidant protection in aged individuals, particularly those at risk of ischemic heart disease, or in those undergoing clinical procedures involving transient periods of myocardial hypoxia (Venardos and Kaye, 2007).

Clearly, the results of clinical studies suggest that an increase in the intake of selenium is associated with health benefits. However, the present focus should be on diagnosing and treating selenium deficiency resulting from a poor diet or disease. Data is being actively accumulated to indicate that Se deficiency is related to reproductive disorders in human, including poor semen quality and pregnancy complications and that Se dietary supplementation may potentially prevent these changes. In addition, Se supplementation during pregnancy and in the postpartum period reduced thyroid inflammatory activity and the incidence of hypothyroidism (Negro *et al*., 2007).

Optimal Se status has been shown to be beneficial in asthma, rheumatoid arthritis, cystic fibrosis, HIV, pancreatitis, brain and neurodegenerative disorders. Recently it was shown that low serum selenium is independently associated with anaemia among older women (Semba *et al*., 2007). Increased Se status may also substantially decrease the negative effects of ingested heavy metals (Watanabe, 2002).

Selenium is protective against oxidising radiation (*e.g.* UV) and can be considered as an anti-ageing agent. For example, low plasma selenium is independently associated with poor skeletal muscle strength in community-dwelling older adults in Tuscany (Lauretani y*et al*., 2007). Similarly, low serum selenium concentrations are associated with poor grip strength among older women (Beck *et al*., 2007). Furthermore, sub-optimal Se status may worsen muscle functional decrements subsequent to eccentric muscle contractions (Milias *et al*., 2006). In elderly people in Spain, serum selenium was associated with self-perceived health, chewing ability and physical activity. In particular, subjects in the upper tertile of serum selenium had more than twice as much probability of reporting good health status, chewing ability and of doing more than 60 min of exercise/day.

Low serum concentrations of selenium can be used as a predictor of subsequent disabilities associated with aging (Bartali *et al*., 2006). Improved Se status has been associated with a reduced risk of osteoporotic hip fracture in elderly subjects (Zhang *et al*., 2006). In the elderly population, those with the lowest selenium levels had a significantly higher risk of mortality over a period of 5 years (Walston *et al*., 2006). Similar conclusions were drawn from an EVA study (a 9-year longitudinal study with 6 periods of follow-up). During the 2-year period from 1991 to 1993, 1389 men and women born between 1922 and 1932 were recruited. The effects of plasma selenium at baseline on mortality were determined. During the 9-year follow-up, 101 study participants died. Baseline plasma selenium was higher in individuals who were alive at the end of the follow-up period than in those who died during prior to this timepoint (Akbaraly *et al*., 2005). It was also shown that elderly women living independently in the community who have higher serum selenium are at a lower risk of death (Ray *et al*., 2006).

The selenium status of the elderly is related to quality of life. For example, recent results of a cross-sectional survey of 2,000 rural Chinese aged 65 years or older from two provinces in the People's Republic of China support the hypothesis that a lifelong low selenium level is associated with lower cognitive function (Gao *et al*., 2007). Indeed, in elderly cognitive decline was associated with decreases of plasma selenium over time. Among subjects who had a decrease in their plasma selenium levels, the greater the decrease in plasma selenium, the higher the probability of cognitive decline (Akbaraly *et al*., 2007).

It has been identified that Se requirement in the USA is 55 μg/day and in the UK it is 75 μg/day for men and 60 μg/day for women.

Addressing Se deficiency in humans via Se-enriched eggs

Since the selenium content in plant-based food depends on its availability from soil, the level of this element in human foods varies among regions. When considering ways to improve human selenium intake, there are several potential options, including the production of Se-enriched eggs, meat and milk (Surai, 2000; Surai, 2002; Surai, 2006) as well as Se-supplements in tablet/capsular form.

Several important factors must be considered when choosing the best food supplementation strategy for a given population. Such factors are shown in *Table 1*. In general, the main sources of dietary selenium differ between different countries. For example, currently in the UK meat and meat products provide 32% daily Se consumption and dairy products and eggs are responsible for 22% Se consumption (BNF, 2001). In contrast, in Russia about 50% Se in the diet originates from bread and cereals and meat, milk and eggs provide about 20%, 10% and 5% daily Se consumption respectively (Golunkina *et al*., 2002). In the USA beef, white bread, pork, chicken and eggs account for half of the Se in the diet (Schubert *et al*., 1987). In Ireland, meat and meat products (30%), bread and rolls (24%), fish/fish products (11%), and milk and yoghurt (9%) were the main contributors to mean daily Se intake (Murphy *et al*., 2002).

In Japan in the alpine communities, fish makes the largest contribution to dietary selenium intake (48% of daily total), followed by eggs (24%), and meat (17%). In the coastal community, fish accounted for 58% of daily total selenium intake, followed by meat (18%), and eggs (16%). In both districts, the total contribution of rice and wheat products was around 10% (Miyazaki *et al.*, 2004).

Table 1 Some characteristics of food choice for Se-enrichment

The food should be	Comments
A part of traditional meals for the population	It would be counter-productive to attempt a change in culturally-based food habits by introducing a new type of food. Emphasis should be given to the possibilities of changing composition of existing foods such as by selenium enrichment.
Consumed regularly in a moderate amount	Since the objective is to deliver the amount of selenium needed to meet RDA it is necessary to choose food which is consumed regularly in moderate amount. Over-supplementation is unnecessary and undesirable.
Consumed by the majority of the population	This is particularly important given that immune function is more likely to be compromised in groups such as children and the elderly.
Affordable	Affordability of food would play an important role in the consumer choice.
Enriched with other health-promoting nutrients that are in short supply in the same population	Examples of minerals critical to health that are frequently deficient include iron and iodine. Vitamin E and lutein are also in short supply in the human diet. This can give a greater improvement in the diet.
Supplying a meaningful amount of the nutrient (*e.g.* at least 50% RDA)	This is an important point that distinguishes true functional foods from products that include 'tag-dressing' amounts of nutrients for advertising purposes.

Among animal-derived products, the egg is ideally suited to meet the requirements mentioned in *Table 1*. The egg is a traditional and affordable food in most countries and is consumed by people of all ages more or less regularly, and in moderation. It is also a very safe vehicle for supplementation given that a toxic dose of selenium from eggs would require consumption of at least 30 eggs per day over time, an unlikely situation. There is an option for simultaneous enrichment of eggs with several important nutrients, including omega-3 fatty acids, vitamin E, carotenoids (Surai and Sparks, 2001; Surai, 2002) and with a single egg it is possible to deliver around 50% of the human RDA for selenium. It appears that pork, beef and chicken meat as well as milk can also be enriched with selenium.

Before the advent of commercially available organic selenium for animal diets, the main problem as regards the enrichment of eggs with selenium was the low efficiency of transfer of inorganic selenium (the selenite or selenate forms) to the egg. In fact, even high doses of selenite in the diet of laying hens were not able to substantially enrich eggs with this trace element (as reviewed by Surai, 2002).

The concept of producing Se-enriched eggs first originated at the Scottish Agricultural College in 1998 (Surai, 2000). Indeed, a wide introduction of organic selenium in the form of Se-enriched yeast into poultry diets was a revolutionary decision, making it possible to produce eggs with an increased Se concentration. Since the main form of Se in the egg is seleno-methionine (Se-met) and chickens cannot synthesise this amino acid, inclusion of sodium selenite into the chicken diet has limited ability to produce enriched eggs. However, Se-met from Se-yeast is effectively transferred to egg yolks and albumin, providing the opportunity to produce Se-eggs.

At the same time as these developments, many media channels around the world have taken the first step towards the commercial production of Se-enriched eggs (*Table 2*). Later it was proven that the consumption of such eggs could provide a good source of Se for humans (Surai *et al*., 2004) and may provide a solution for global Se deficiencies in humans.

Table 2 Media output related to the super egg development (adapted from Surai, 2002).

Title	Newspaper	Date
Super egg that could poach the vitamin pill market	Daily Mail	June 12, 1998
Science goes to work on an egg	The HERALD	June 12, 1998
Super egg	Cambridge Evening News	June 12, 1998
Good health is no yolk	The EXPRESS	June 12, 1998
Scientists go to work on creating "super-egg"	The TIMES	June 12, 1998
Experts crack the super eggs's secret	The EXPRESS	August 2, 1998
Scientists develop a natural panacea: New super egg bid to allay killer diseases	The HERALD	April 5, 1999
Scientists go to work on a super-egg	The GUARDIAN	April 7, 1999
Scots to market "life-saving" eggs	The SUNDAY TIMES	April 5, 1999
Super-eggs to help fight against cancer	METRO	April 7, 1999
Could SUPEREGG save your life?	The EXPRESS	April 8, 1999
The egg that goes to work on your health	Daily Mail	April 7, 1999
New enriched egg could bring health benefits	Farmers Guardian	April 9, 1999

Se-enriched eggs in a global context

Today, Se-enriched eggs are produced in more than 25 countries world wide, with the Eastern European countries progressing the furthest in this regard. Russia is currently the most advanced country in this business, generating around 38 billion eggs, with 40% of poultry farms producing eggs with increased levels of Se, vitamins, PUFAs and other functional compounds (Fisinin, 2007). There are more than 20 poultry businesses in Russia producing Se-eggs commercially. They are situated in various regions of the country ranging from St. Petersburg up to Siberia and the Far East. Generally they are not competing with each other on the local markets. In most instances, these eggs are sold with distinguishable names and brands including "Rejuvenating", "Aksais's sun", "Spring of Cheerfulness", "Universal", "Cossack Village Eggs", "Oval Wonder", "Strong eggs", "Activita", "Selena", "Healthy Selenium" (*Table 3*).

The level of Se delivered in a single Russian enriched egg varies from 20 up to 35 μg. In many cases eggs are simultaneously enriched with vitamin E, however, as a rule, the amount of vitamin E delivered from a single egg is less than 30% RDA. Prices for Se-enriched eggs vary and are usually higher by 10-50% in comparison with normal table eggs. The level of production of Se-eggs as a percentage of total egg production on these farms varies from 1 to 20%.

Much more advanced Se-egg production has been developed by Langut Ukraine, a company located in the Kiev region. The egg under the brand "Bag of Life" and a trade mark "Eggs from a good hen" are produced at the level of 1.2 million eggs daily and sold all over the Ukraine. In fact, all of the eggs which are produced by the company are Se-enriched. A single egg delivers about 30-35 μg Se (50% RDA), about 15-20 mg vitamin E (100% RDA) and also contains natural carotenoids.

It is interesting to note that practically all of the aforementioned Se-eggs are produced using Se-yeast in the commercial form of Sel-Plex (Alltech Inc, USA) as a major source of Se for laying hens at the level of 0.3-0.5 ppm in feed. One important advantage for Russia and the Ukraine in terms of Se-egg production is that they do not need to comply with EU feed additive legislation for local use and have strong marketing support.

Table 3 Some examples of Se-enriched eggs produced in various countries.

Country	Brand name of Se-eggs
Columbus	UK, Belgium, Netherlands and other countries
Origin	Northern Ireland
Mega-Eggs	Ireland
NutriPlus	Malaysia
LTK Omega Plus	Malaysia
Selenium Plus	Malaysia
TPC Egg with Organic Selenium	Malaysia
Selen Egg	Thailand
Doctor Hen Egg	Thailand
Bounty Eggs	Philippines
Organic Selenium Egg	Singapore
Bon Egg	Columbia
Mr Egg	Mexico
Heart Beat eggs	New Zealand
Tavas Yumurta	Turkey
Seker Yumurta	Turkey
Selenyum eggs	Turkey
NutriPlus	Portugal
Omega Pluss	Hungary
Vi Omega-3	Greece
Splepacich Vajec Eggs	Slovakia
Bag of Life (Koshik zhitja)	Ukraine
Spring of Life (Dzherelo zhitja)	Ukraine
Rejuvenating (Molodiljnije)	Russia
Aksais' sun (Aksaiskoye solnishko)	Russia
Spring of cheerfulness (Rodnik bodrosti)	Russia
Cheerful egg (Bodroe)	Russia
Universal (vSELENskoye)	Russia
Cossack Village Egg (Stanichnije)	Russia
Beautiful hen (Chochlatka)	Russia
Aktivita	Russia
Dr. Selenium	Russia
Oval Wonder	Russia
Mettlesome eggs (Molodetskoye)	Belarus

Safety of Se-enriched eggs

Se-enriched eggs, as a rule, contain up to 30 µg Se per egg. Since the maximum safe dietary Se intake (average NOAEL: 'no observed adverse effect level') is 819 µg (Whanger *et al*., 2004), to have any detrimental effect from Se overdose one must consume more than 25 eggs a day for a long period of time. If we take into account maximum safe dietary intake of Se identified by Food Nutrition Board (2000) to be 400 µg, one can consume 13 eggs a day for a long period of time, a situation difficult to imagine. In most European and developed countries, egg consumption is less than one per day, therefore, the safety margin here is more than 10-fold.

Observations with Se-egg production in various countries indicate the following:

1. Costs involved in Se-egg production does not normally exceed 2% of the total feed costs
2. Organic Se supplementation of laying hens is associated with increased egg production, better shell quality, internal egg quality (Hough Units) and improved FCR. These parameters pay money back and give profit at the level of 1:3-5. Therefore a label "Se-enriched" is usually free of charge and can be used as an effective marketing tool for promotion.
3. Additional inclusion of Se to already existing modified eggs (omega-3, vitamin E-enriched, iodine-enriched, etc.) can further enhance their quality and marketing potential without substantial increase in price.
4. Labelling regulations differ substantially from country to country, however, a two-fold increase in Se content of the egg would fit the "Se-enriched" category of the most countries.
5. Some countries (*e.g.* Eastern European and Asian) allow claims for the health benefit of Se, but in most areas it is only possible to put level of Se on the label and give a comparison to RDA. Even such limited labelling would be a great advantage for producers.

The prospects for increased production of Se eggs worldwide are great and a major limitation in Se-egg production is a lack of public knowledge concerning the beneficial effects of Se in relation to human health. Indeed, the companies producing Se-eggs should invest more into the public education to widen the market for Se-eggs.

It seems that the Se form expressed in eggs is highly nutritionally available. A recent clinical trial conducted in the Ukraine showed that consumption of two Se-enriched eggs per day for eight weeks significantly increased the Se level of the plasma of volunteers (Surai *et al*., 2004). Eggs consumed in the control group contained 7-9 μg Se/egg and test-group eggs were enriched with selenium in the range of 28-32 μg Se/egg. Blood was collected at the beginning and the end of experimental period and Se was determined in plasma by hydride generation atomic absorption spectrometry with fluorometric detection. The level of selenium in plasma of volunteers living in the Kiev area of Ukraine (0.055-0.081 μg /ml) was on the low side of the normal physiological range and was lower than reported in previous studies conducted with volunteers in Scotland (Surai *et al*., 2000). Consumption of commercially available eggs for eight weeks only slightly increased Se in plasma, which reached physiological level (0.075-0.085 μg/ml). Consumption of two enriched eggs daily, which delivered the daily requirement of 55-65 μg Se, for eight weeks, was associated with a significant increase in Se concentration in plasma. Plasma Se reached 0.09- 0.14 μg/ml, indicating improving Se status of volunteers (Surai *et al*., 2004).

This is the first clinical trial proving that selenium-enriched eggs can be used to improve selenium status in countries with low Se status, such as Scotland or Ukraine. Se availability from eggs for human supplementation needs further elucidation and the effects of different dietary sources of Se on concentration in plasma probably depends on the initial Se status of the individual.

This study was very important for the Ukraine region, as Se deficiency has been documented in people working in the Chernobyl area (Tutelyan *et al*., 2002; Golunkina *et al*., 2002). Selenium and other antioxidants can be especially beneficial for people living in radionuclide-contaminated areas of the Ukraine.

In the UK the only designer eggs available through the major supermarkets are the 'Columbus' brand produced by the Belgium company Belovo. These eggs, enriched in n-3 fatty acids and vitamin E, and first appeared in Belgium in 1997. Since then they have been sold in the UK (1998), Netherlands (1999) and India, Japan and South Africa

(2000). Current production of the Columbus egg exceeds 50 million eggs per year in Europe. To satisfy consumer demand in the UK, free range Columbus eggs enriched with n-3 PUFAs, vitamin E and selenium are also on the supermarket shelves. These eggs are characterised by a balanced nutritional lipid composition (C18, n-6: n-3=1:1) and a favourable structural lipid ratio (long-chain PUFA, n-6: n-3 = 1:3).

Conclusions

Se-eggs are perfectly suited for the category of functional foods. A single egg can deliver 50% RDA in Se and since most of European countries are Se-deficient (Surai, 2006), this could have additional benefits, beyond those provided by normal eggs. Eggs form an essential part of many different foods and dishes and could enhance their quality beyond nutritive value. Se-enriched eggs could also have a substantial effect of gastro-intestinal functions (one of the purposes of functional foods) providing Se for the antioxidant enzyme GI-GSH-Px, which is responsible for prevention of oxidized lipid absorption and may also protect against heart diseases and cancer. Furthermore, Se delivered in eggs could have a beneficial effect on the antioxidant/pro-oxidant balance in the intestine (Surai, 2006).

Regarding diversity in enriched poultry products, it is interesting to note that Se-enriched quail eggs are already commonly seen on supermarket shelves in Ukraine and Belarus. Se-enriched meat and milk production is a next step in widespread functional food production.

Decreased Se levels in feeds and foods in many cases reflect the consequences of our agricultural practises. For example, usage of inorganic fertilizers rich in sulphur interferes with Se assimilation from soil as well as soil acidification decreases Se availability. Therefore, eggs produced by free-range poultry fed on natural feed sources grown on well-balanced soils 100-200 years ago would have contained much higher Se concentrations than we currently see in eggs from many European and Asian countries. Recent observations (Pappas *et al.*, 2006) indicated that Se level in eggs from wild birds are substantially higher than in commercial hatching eggs. Se-enrichment of eggs, meat and milk may be viewed as merely production of naturally-designed food ingredients. Indeed, production and commercialisation of such organic Se sources as Selenised yeast have already opened a new era in Se supplementation of animals and has given a real chance for producers to differentiate and add value to their poultry products and to meet the increasingly diverse requirements of consumers.

Se-eggs in many countries have successfully made their way from niche markets to main stream food sales. Indeed, it is possible to provide consumers with a range of animal-derived products that have been nutritionally improved in such a way that they can deliver substantial amount of health-promoting nutrients to improve the general diet and help to maintain health. Therefore, without changing eating habits and traditions of various populations, it is possible to solve problems related to deficiency of various nutrients, in particular selenium. The consumer will go to the same supermarket to buy the same animal-derived products (egg, milk and meat), cook and consume them as usual. The only difference will be in the amount of specific nutrients delivered with such products.

"Diet cures more than lancet"

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