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NEW TRENDS IN FUNCTIONAL FOOD OF ANIMAL ORIGIN

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Abstract

There are physiologically active components in foods from both plants and animals, that potentially could reduce the risk of chronic diseases. These are functional foods. The most importants of these active components- discussed in the present paper- are omega-3 fatty acids, conjugated linoleic acid, and probiotics with many health promoting effect.

Key words: functional foods, omega-3 fatty acids, conjugated linoleic acid, probiotics

INTRODUCTION

„Let food be the medicine and medicine be the food"- the tenet was embraced ~2500 years ago by Hippocrates, the father of medicine. In the 1900s, the important role of diet in disease prevention and health promotion came to the forefront once again (Hasler, 2002). Four strategies have been offered to fix the food crisis caused by over abundance, and one- if not the most important of them- are the functional foods. Scientists began to identify physiologically active components in foods from both plants and animals that potentially could reduce risk for a variety of chronic diseases (Hasler, 2002). There has been recently an explosion of consumer interest in the health enhancing role of specific foods, containing physiologically/ biologically active components in addition to the nutrients, so called functional foods (Hasler, 1998). Hasler's opinion (1998) is that all foods are functional, as they provide taste, aroma, or nutritive value. On the other hand, Institute of Medicine's Food and Nutrition Board Country (IOM/FNB, 1994) defined functional foods as „any food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains". Functional attributes of many traditional foods are being discovered, while new food products are being developed with beneficial components. Although the majority of physiologically active food components are of plant origin, animal products also have several substances with a potential role in health promotion. This article reviews the literature concerning animal food components that have been linked with human physiological benefits. The importance of these products is also confirmed by the actual consumption trends of these kind of foods (Madai, 2008).The spread of this new topic is very important among veterinarians and other animal and food scientists, in order to optimise public health, through healthier food products, by improving animal nutrition and food processing (Prates and Mateus, 2002).

Ω-3 fatty acids

Omega-3 fatty acids are an essential class of polyunsaturated fatty acids (PUFA). The major PUFAs are eicosapentaenoic acid (EPA, C20:5, n-3) and docosahexanoic acid (DHA, C22:6, n-3) (Prates and Mateus, 2002). DHA is an essential component of the phospholipids of cellular membranes, especially in the brain and retina of the eye, and is necessary for their proper functioning. DHA is particularly important for the development of these two organs in infants (Crawford, 2000). Canada has established the Canadian Recommended Nutrient Intake (CRNI) of n-3 PUFA at 0.5% of energy. It has been suggested, that the so called Western- type diet is currently deficient in n-3 fatty acids, which is reflected in the current estimated n-6 to n-3 dietary ratio of 20:25-1, compared to the estimated 1:1 ratio on which humans evolved (Simopoulos, 1991). Around 10000 B.C the estimated n-6: n-3 ratio of human food was 1:1. By 1950, this changed to 10:1, and by 2000 the value is 20:1 (Leaf and Weber, 1987). The role of the omega-3 fatty acids in the human body are the followings:

- reduces the blood cholesterol and triglicerid levels
- reduces inflammation symptoms
- Improves the efficiency of the immune system
- good effects on digestion
- reduces the risk of gastro- intestinal tumours, and helps cancer patients
- prevents premature birth
- better retina function
- reduces blood pressure
- more effective digestion with increasing bile output
- reduces allergic diseases
- prevent diabetes
- prevent depression
- wide range of use

This has prompted researchers to examine the role of n-3 fatty acids in a number of diseases –particularly cancer and cardiovascular diseases (CVD)- and more recently, in early human development (Prates and Mateus, 2002). Hundreds of clinical studies have been conducted investigating the physiologic effects of n-3 fatty acids in such chronic conditions as cancer, rheumatoid arthritis, psoriasis, Crohn's disease, cognitive dysfunction and cardiovascular disease (Rice, 1999), with the best documented health benefit being their role in heart health. Metaanalysis of 11 randomised control trials suggests that intake of n-3 fatty acids reduces overall mortality, mortality due to myocardial infarction and sudden death in patients with CHD (Bucher et al, 2002).

Nowadays the daily omega-3 amount is only the 8-12 % of the recommended daily intake, and the omega-6 amount is 1000-2000 % of the recommended- which is really harmful and unhealthy to human organs.This imbalance could be changed by eating omega-3 rich foods: salmon, tuna, mackerel, sardines, herring, eel, trout, and some other fish. Food companies continuously design newer and newer omega-3 rich functional foods so in the future we can buy omega-3 rich pork meat, and meat products, omega-3 rich milk (milk fat composition can be modified to contain higher levels of human healthy fatty acids , such as omega-3 fatty acids, Pulina et al, 2006), omega-3 rich freshwater fish. Omega-3 enriched eggs can be produced by modifying hens diets (Lewis et al, 2000) and furthermore the egg will continue to play an important role in the changing face of functional foods (Hasler, 2000). The different foods of animal origin, such as meat, meat products, milk and milk products' fatty acid composition can be modified by nutrition. The animal's meat fatty acid composition depends on the age, breed, sex, but mostly on the nutrition. 11% of flaxseed in the porks' feed increased the omega-3 fatty acid percent of the meat, and had no effect on the animals' meat quality (Mavromichalis, 2001). Feeding cows with different oil seeds increased the omega-3 fatty acid percent of the meat as well, without worsen the meat quality (Scheeder et al, 2001).

Increasing the amount of unsaturated fatty acids in meat means that there is a greater possibility of oxidation, a process that has undesirable sensory or health effects. There are several ways of minimising lipid oxidation and some of them are associated with animal feeding (Decker et al, 1998). Vitamin E-supplemented diet in poultry, pigs and cattle prolongs the shelf-life of these products. The antioxidant activity reduces rancidity and helps the meat retain its colour (Pszczola, 1998). Feeding strategies have been successfully used to produce eggs, beef and chicken with up to 20 times the normal level of DHA, 7 times the normal level of vitamin E and 6 times the normal omega-3 content of their traditional counterparts (Sloan, 2000).

We conducted a feeding trial with cows of beef cattle. Omega 3 enriched concentrate were fed for 4 weeks for 13 cows and normal diet for the control group (13 cows). Our results show that nutrition can significantly alter fatty acid composition of meat and milk even at ruminants. The omega 6 and omega 3 fatty acid ratio were in meat (biopsy sample) 5.7 and 3.9, in milk 14.5 and 4.9, in lymphocyte cell membrane 3.5 and 2.3 in control group and omega 3 group respectively. Omega 3 fatty acid ratio of total fatty acids in percent increased 2.21 times more in meat, 2.53 in milk and 1.25 in lymphocyte cell membrane compared to control group. As functional food production meat and milk have importance, the lymphocyte results give us information on membrane lipid composition, and predict its physiological consequences.

Conjugated linoleic acid (CLA)

Much attention has been directed toward conjugated linoleic acid (CLA) since the discovery of its anticarcinogenic properties two decades ago, and many other biological activities have been reported over the past few years (Collomb, 2006). Several animal experiments have shown anticarcinogenic and antiatherogenic properties as well, as an influence on body fat and energy metabolism. CLA is found naturally in ruminant fats and dairy products, thus beef and cow milk are the main sources for human consumption. Only 10% of the CLA content of ruminants meat was found in monogastric animals. Comparing to fish, and other sea animals CLA content was even lower (Csapó et al, 2001). O'Shea et al, (1998) made efforts to manipulate naturally the CLA content of milk and animal tissue by dietary intervention. Such research may lead to the development of new high CLA-containing 'functional foods' designed for cancer chemoprevention. Cows' milk fat is the richest natural common source of CLA. Levels in milk ranging from 2 to 37 mg g^{-1} fat have been recorded (Stanton et al, 2003) and recently *cis*-9,*trans*-11 CLA contents of 53.7 mg g^{-1} of FA (Shingfield et al, 2006) and 51.5 mg g^{-1} of total milk fat (Bell et al, 2006) were reported. This large range in CLA values can be attributed to a number of factors. Diet is the most significant factor affecting the CLA content of milk fat. High values often occur with the feeding of fresh pasture (Chilliard et al, 2001). However, much higher CLA levels were found when suitable total mixed rations (TMRs) including safflower or fish oil were fed or when monensin, an antibiotic food additive, was used in combination with such TMR (Shingfield et al, 2006). Breed (Kelsey et al, 2003) and lactation number or age (Stanton et al, 1997) can have a small influence on CLA levels. However, cows can exhibit large individual variation in CLA levels (Peterson et al, 2002).

Beef and lamb meat have been suffered from a negative health image related to the nature of their lipid fraction. Additionally, the CLA, this anti-carcinogenic fatty acid was first isolated from grilled beef in 1987 (Ha et al, 1987). Interestingly, CLA increases in foods that are cooked and/or otherwise processed. Over the past decade, CLA has been shown to be effective in supressing forestomach tumours in mice, aberrant colonic crypt foci in rats, and mammary carcinogenesis in rats (Ip and Scimeca, 1997). CLA has been investigated for its ability to change body composition, suggesting a role as a weight reduction agent by reducing fat deposition and increasing lipolysis in adipocytes (Park et al, 1997).

Probitics

The word "probiotics" was initially used as an antonym of the word "antibiotic". It is derived from Greek words and translated as "for life" (Hamilton-Miller et al, 2003). In the other hand probiotics are defined as viable microorganisms that are beneficial to human health (Salminen et al, 1998). It is estimated that over 400 species of bacteria, separated into two broad categories, inhabit the human gastrointestinal tract. The categories are: those considered to be beneficial (e.g. Bifidobacterium and Lactobacillus) and those considered detrimental (e.g. Enterobacteriaceae and Clostridium spp.). Of the beneficial micro-organisms traditionally used in food fermentation, lactic acid bacteria have attracted the most attention (Sanders, 1994). Although a variety of health benefits have been attributed to probiotics, their anticarcinogenic, hypocholesterolemic and antagonistic actions against enteric pathogens and other intestinal organisms have received the most attention (Mital and Garg, 1995). The health benefits of probiotics have been considered since the turn of the century, when the Nobel- prize winning microbiologist Metchnikoff first postulated that lactic acid bacteria contributed to the longevity of Bulgarian peasants (Fuller, 1992). Various researchers summarized the scientific support for the therapeutic and preventive use of probiotics for various health concerns including cancer, intestinal tract function, immune function, allergy, stomach health, urogenital health, cholesterol lowering, and hypertension (Sanders, 1999).

Daily products, especially fermented daily products are the best sources of probiotics (and calcium). Probiotic cultures have been exploited extensively by the dairy industry as a tool for the development of novel functional products. While it has been estimated that there were.approximately 70 probiotic-containing products marketed in the world (Shah, 2004), the list has been continuously expanding. Traditionally probiotics have been incorporated in yoghurt; however, a number of carriers for probiotic have been examined recently including mayonnaise (Khalil and Mansour, 1998), edible spreads (Charteris et al, 2002) and meat (Arihara et al, 1998) in addition to other products of dairy origin i.e. cheese (Ong et al, 2006) or cheese-based dips (Tharmaraj and Shah, 2004). Probiotic organisms are also available commercially in milk, sour milk, fruit juices, ice cream, single shots and oat-based products. Lunebest, Olifus, Bogarde, Progurt are only some examples ofcommercial fermented dairy products with probiotics available on the international market with a steady increase in the market shares.

CONCLUSIONS

Increasing evidence supports the observation that foods from animal sources containing physiologically active components may enhance human health (Prates and Mateus, 2002). Moreover diet is only one component of an overall lifestyle that can have an impact on health, other components include smoking, physical activity and stress (Hasler, 1998). The field of functional foods, however, is in its infancy. Claims about health benefits of functional foods must be based on sound scientific criteria (Clydesdale, 1997). Research into functional foods will not advance public health unless the benefits of the foods are effectively communicated to the consumer. The Harvard School of Public Health (Boston, Mass.) and the International Food Information Council Foundation (Washington, D.C.) recently released a set of communication guidelines, aimed at scientists, journal editors, journalists, interest groups, and others for improving public understanding of emerging science (Hasler, 1998). The guidelines are intended to help ensure that research results about nutrition, food safety, and health are communicated in a clear, balanced, and nonmisleading manner (Fineberg and Rowe, 1998). Finally, those foods whose health benefits are supported by sufficient scientific substantiation have the potential to be an increasingly important component of a healthy lifestyle and to be beneficial to the public and the food industry (Hasler, 1998).

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