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CERTIFICATE

This is to certify that Dr. Ugur Gogus from Middle East Technical University of Turkey has taken part in the 6th International Conference of Food Science and Technology which was held in the South China University of Technology, Guangzhou, China. He has also presented his paper entitled **N-3 Omega-The Miracles of Today's Nutrition. What about future?** in the session of Food Nutrition and Evalution at 13:30~13:50 pm, Nov. 8, 2005. His lecture has been well received by the audiences.

International Conference on
Food Science and Technology VI

J. Cai

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to 6th International Conference on Food Science and Technology

n-3 Omega-The Miracles of Today's Nutrition as Medical Nutrients. What About Future?

Ugur Gogus*

Middle east Technical University/Vocational School of Higher Education/06530/Ankara/Turkey

*Corresponding author: Ugur Gogus Email:gugur@metu.edu.tr

The very long chain Polyunsaturated Fatty Acids(PUFAs)(C_{18}-C_{22}) and n-3 omega PUFAs, rich from these fatty acids, seem to gain a great acceptance in today's nutrition and healthcare with their beneficial effects on metabolism. Especially, the protective effect of the concerned fatty acids, against cardiovascular and inflammatory diseases including cancer, made them uncomparably beneficial than other dietetics. Unfortunately, lack of studies as related to their ergogenic effect in sports, cholesterol reducing effect in meat technology, effect on serum profile in human metabolism and application dose with/without omega 6 PUFAs with the side effects, brought us important questions about these PUFAs to be highlighted. We still do not know the exact n-3 omega supplement doses with their possible contraindications in the case of combined use with other drugs and supplements. The other side of n-3 omega PUFAs, which protect and even enhance the effect of madical treatment of important diseases such as Alzheimer, Multiple Sclerosis(MS) and cancer, was also confirmed with many researches, makes them as the miracles of today's nutrition. What about future? We will wait and see their future with other studies, highlighting the missing details and questions. Perhaps their value and site in nutrition and healthcare will continue by increasing in the near future.



International Conference on Food Science and Technology VI

South China University of Technology

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November 7-9, 2005

BOOK OF ABSTRACTS

Editors in Chief

Biansheng LI, Junpeng CAI, Shujuan YU, Lin LI

South China University of Technology Press
Guangzhou

hydrolyzing degree 18.63%. Secondly, four fractions were got after separated by strongly acidic styrene type cation exchange resin. Finally, there were two fractions of the four separated can enhance lymphocyte proliferative responses. Immunomodulating fractions which can enhance lymphocyte proliferative responses were contained in wheat protein.

Keywords: wheat protein, wheat peptides, alcalase, immunostimulating activity

F90211

Effect of the Diet Intervention and Sports Nutrition Foods for Chinese Elite Male Bodybuilders on Body Composition and Physical Fitness during the Period before Competition

Jin ZHOU*, Fenghua SUN, Wenying WANG, Yanlong HU, Jinzhu PANG, Ying JIAO
Beijing Competitor Institute of Sports Nutrition, Beijing, China
Jin ZHOU's E-mail: zhoujinjoey@163.com

The purpose of this investigation was to document the effect of a 6-week precompetition bodybuilding diet intervention and sports nutrition foods on body composition and physical fitness of three Chinese elite male bodybuilders. Three adult males, preparing for Asian Bodybuilding Championship were tested. The 6-week precompetition diet and sports nutrition foods of three bodybuilders were investigated and analyzed. And the levels of carbohydrates, protein and fat intake and the distribution of calories intake of the meals were analyzed. The levels of body composition, blood biochemical and the levels of plasma electrolytes were detected. Initial average body weight of 78.9±9.0kg decreased to 71.7±3.8kg from 6-week precompetition to 2-week precompetition. And the average body fat of 9.6±2.2% decreased to 4.0±1.0%. Blood samples for BUN, CK and LDH indicated intense training. Increased BUN levels may be attributed to a high protein diet. The levels of plasma electrolytes including potassium, sodium and chlorine were at normal levels during 6-week precompetition. The strict diet and sports nutrition foods enabled the subjects to lose fat weight and induced substantial changes in body composition predictably in preparation for the contest. Caution taken to avoid excessive physiologic stresses on the body during precompetition diet and training.

Keywords: bodybuilding, bodybuilder, diet and sports nutrition foods, precompetition, body composition, enginery

F90228

n-3 Omega—The Miracles of Today's Nutrition as Medical Nutrients. What About Future?

Ugur GOGUS
Middle East Technical University, Vocational School of Higher Education, 06530, Ankara. Turkey
Ugur GOGUS's E-mail: gugur@metu.edu.tr

The very long chain Polyunsaturated Fatty Acids (PUFAs)(C_{18}-C_{22}) and n-3 omega PUFAs, rich from these fatty acids, seem to gain a great acceptance in today's nutrition and healthcare with their beneficial effects on metabolism. Especially, the protective effect of the concerned fatty acids, against cardiovascular and inflammatory diseases including cancer, made them uncomparably beneficial than other dietetics. Unfortunately, lack of studies as related to their ergogenic effect in sports, cholesterol reducing effect in meat technology, effect on serum profile in human metabolism and application dose with/without omega 6 PUFAs with the side effects, brought us important questions about these PUFAs to be highlighted. We still do not know the exact n-3 omega supplement doses with their possible contraindications in the case of combined use with other drugs and supplements. The other side of n-3 omega PUFAs, which protect and even enhance the effect of madical treatment of important diseases such as Alzheimer, Multiple Sclerosis (MS) and cancer, was also confirmed with many researches, makes them as the miracles of today's nutrition. What about future? We will wait and see their future with other studies, highlighting the missing details and questions. Perhaps their value and site in nutrition and healthcare will continue by increasing in the near future.

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Preface

The International Conference on Food Science and Technology (ICFST) was initiated and has been organized for five consecutive times by Southern Yangtze University and University of California, Davis since 1991. Thanks to their unending efforts, unwavering determination and dedication, as well as immense support from relevant organizations both from China and the USA, it has blossomed into a major international biennial event with ever-increasing participations from both the scientific community and industry around the world. ICFST, which is second to none in China in terms of importance and influence, has since become a well-known forum for high-caliber scientists, technologists and students alike to report their new findings, improve their understandings on topics of their interests, share thoughts and exchange ideas, strengthen ties with existing partner(s) and/or develop collaborative relationships with new partner(s) and make new friends with people from other countries. It has also been maturing into an ideal setting for food and beverage industry to exhibit their products.

Since the last conference which was held in Wuxi, Jiangsu Province, China in 2003, we have seen a great deal of development and change occur, not just in our daily lives, but also in food science systems and industry. Hence, This conference is a great opportunity for food scientists, technologists, students and business people to improve their understanding of key topics that impact the development of products and food processes for health and well-being.

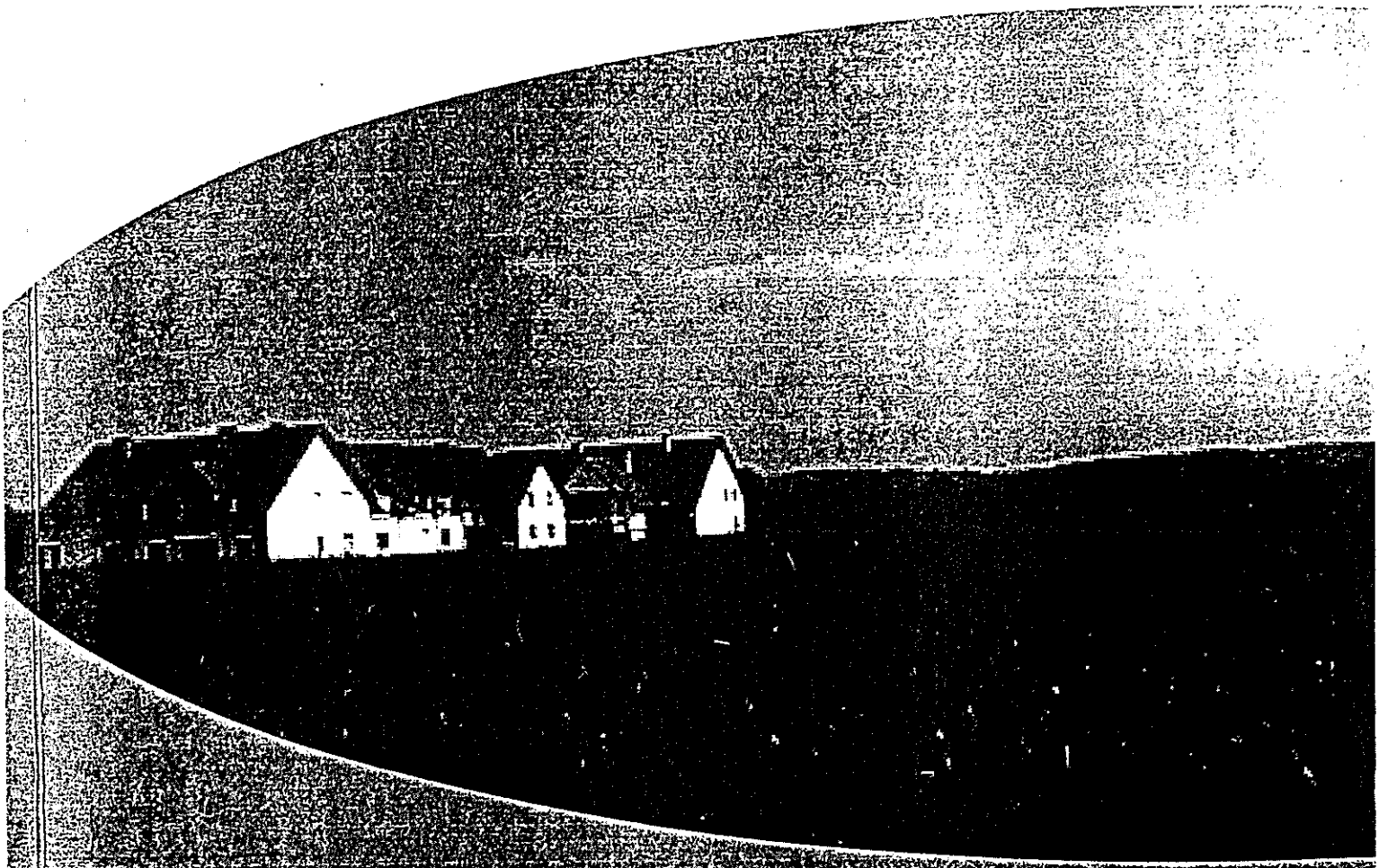
Over the past 9 months, ICFST VI has collected over 400 high quality abstracts and 200 full papers from over 20 countries/regions including China (mainland, Hong Kong, Taiwan), USA, Canada, Australia, UK, Ireland, Holland, Czech, Turkey, Japan, Korea, Indonesia, Thailand, India, Sri Lanka, Bangladesh, Iran, and as far as Ethiopia, covering the following 9 topics: A) Food Processing and Preservation, B) Food Packaging, Materials and Equipments, C) Beverage and Fermentation Technology, D) Food Safety, E) Functional Food and Bioactive Factors, F) Food Nutrition and Evaluation, G) Food Chemistry and Biotechnology, H) Food Sensory and Flavours, I) Food Texture and Rheology. This has fully demonstrated the great importance of this conference attached by food scientists and technologists from around the world. To better serve our delegations in this conference, we have compiled a formal book of abstracts with an ISBN code. This book could be used as a guide for this 3-day conference and of course, can also be used as reference points to start new researches. This book could also be treated as a reference book and be kept in the personal or public libraries.

Lastly, we wish you a very pleasant stay in SCUT, Guangzhou.

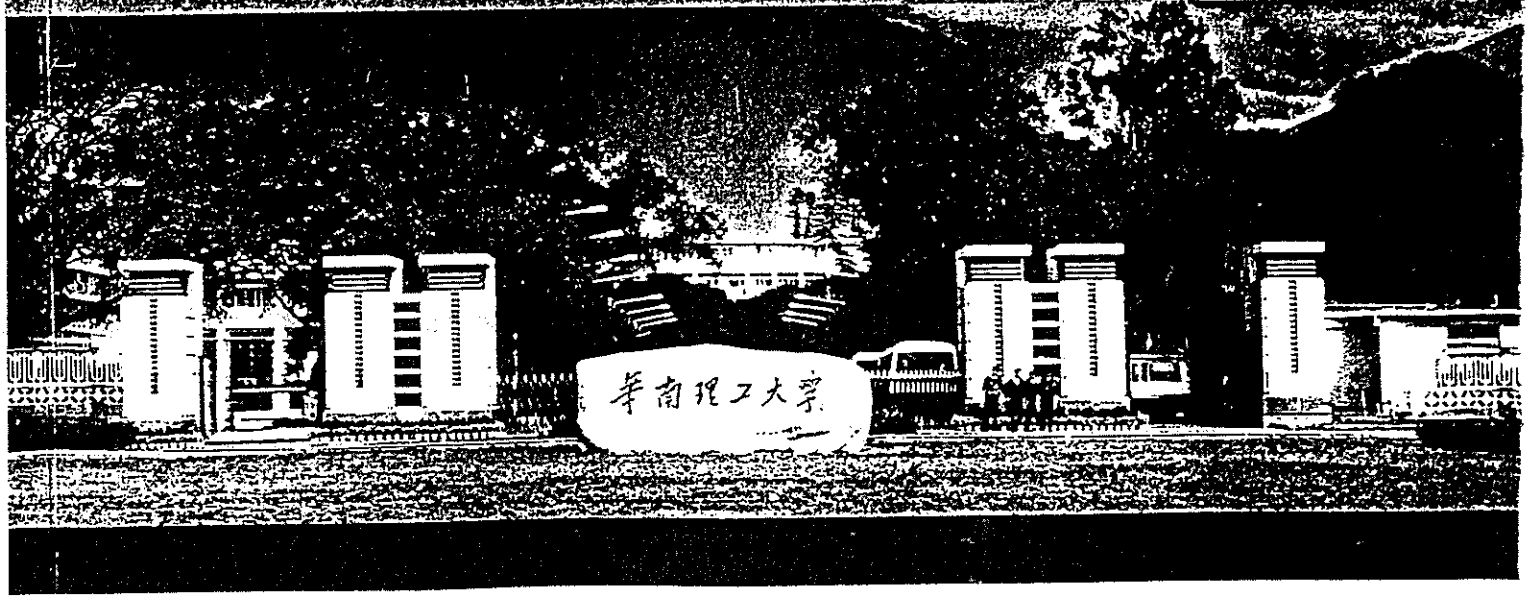
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of the ICFST VI
Oct. 29, 2005

Food Processing for Health and Well-being

International Conference on Food Science and Technology VI
The Annual Meeting of CIFST IV



November 7 ~ 9, 2005
South China University of Technology (SCUT)
Guangzhou, CHINA



10:25~10:45	C70501	Yan Zhang, Sentai Liao, Mingwei Zhang, Zongyao Deng	Stability of Vitamin C in Bitter Gourd Juice	zhangyanhb@tom.com Guangdong Academy o Agricultural Sciences
10:45~11:05	C71906	Yifeng Lin, Pingfang Yang	Studies on production craft of nutritious apple vinegar	linyifeng8@126.com Yuncheng University
11:05~11:25	C72910	Yanhong Ran, Zhifei Chen	Study on chitosan microspheres co-immobilized Laccase and Manganese Peroxidase from Coriolus versicolor	tranyh@jnu.edu.cn Jinan University
11:25~11:45	C52055	Xiuyan Zhang, Guoqing He*, Xingjun Tang, Qihe Chen, Hui Ruan	Enhancement of the Thermostability of ß-Glucanase by Directed Evolution	xiuyanzhang73@126.cor Department of Food Science and Nutrition, Zhejiang University, Hangzhou 310029, Chin
12:00-13:30	**Lunch break**			

Topic F: Food Nutrition and Evaluation

Chairpersons: **Dr. Makoto Ohkubo, Prof Pingfan Rao (13:30-16:25)**

3:30~13:50	F90228	Ugur Gogus	n-3 Omega-The Miracles of Today's Nutrition as Medical Nutrients. What About Future?	gugur@metu.edu.tr Middle east Technical University, Vocational School of Higher Education 06530, Ankara. Turkey
13:50~14:10	F50168	Qiuping Yang*, Lianzhou Jiang	The Action of Soybean Production on Increasing Function and Characteristic of Bakery	sovtb@163.com The National Research Center of Soybean Engineering and Technology
14:30~14:50	F70802	Wanzhu Chen, Hanming Rui, Haitao Yuan, Ling Zhang	Analysis of Dynamic Chemical Changes in Chinese Cantonese sausage: Factors Influencing Content of Nitrite and Formation of Flavor Substances	minisoda@tom.com South China University of Technology
14:50~15:10	F72901	Songyi Lin, Jingbo Liu, Sheng Cheng	Anti-anoxic and anti-fatigue effects for the functional liquid in mice	linsongyi730@163.com Jilin University.
15:10~15:30	F73013	Haimei Wang, Guowei Le, Yonghui Shi	Influences of oxidation-reduction state on the absorption and utilization of iron in rats	whmhehe@163.com Southern Yangtze university
15:30~15:45	**Coffee break**			

Theme

Food Processing for Health and Well-being

Topics

1. Food Processing and Preservation
2. Food Packaging, Materials and Equipments
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Time

November 7-9, 2005

Venue

South China University of Technology (SCUT), Guangzhou, China
Conference Centres:

(1) plenary session: old gymnasium
(2) ICFST sessions: mainly in the IBM business building
(3) CIFST sessions: mainly in the Shaw Humanity and Shaw Science buildings
(4) Exhibition: in Shaw Humanity buildings

The miracles of today's nutrition as medical nutrients. n-3 Omega fatty acids. What about in the future?

*Ugur Gogus

*Food Technology Program, Vocational School of Higher Education, Middle East Technical University, 06531, Ankara, TURKEY.

To whom all correspondence should be addressed.

E mail: gugur@metu.edu.tr

Tel: +90 312 2103653

Fax: +90 312 2101239

n-3 Omega Fatty Acids. Nutrition. Food. Public health and Disease. PUFA.

ABSTRACT

The very long chain Polyunsaturated Fatty Acids(PUFAs)(C_{18}-C_{22}) and n-3 omega PUFAs, seem to be widely accepted in today's life and nutrition style because of their beneficial effects on the metabolism. Especially, the protective effect of the concerned fatty acids, against cardiovascular and inflammatory diseases including cancer have made them uncomparably more beneficial than other dietetics. Unfortunately, lack of studies related to their ergogenic effect in sports, cholesterol reducing effect in meat technology, effect on serum profile on human metabolism, the application dose and the side effects with/without omega 6 PUFAs, have left us with crucial questions to be clarified. We still do not know the correct doses of n-3 omega with their possible contraindications when combined with other drugs and supplements. The other aspect of n-3 omega PUFAs, which is that it protects and even enhances the effect of medical treatment of important diseases such as Alzheimer, Multiple Sclerosis(MS) and cancer has also been confirmed with many researches and makes them the miracles of today's nutrition. What about in the future? We will wait and see their future with other studies. Perhaps, their value and position in the field of 'clinic nutrition and healthcare' will continue at an increasing rate.

79

80

81 **Introduction**

82 n-3 omega PUFAs as long chain polyunsaturated fatty acids, found in plant and marine sources unlike
83 saturated ones, have often been associated with many health benefits such as treating hypertension, rheumatoid
84 arthritis and coronary artery disease(**Freeman 2000**). The role of n-3 omega PUFAs on cancer and also on other
85 clinic disorders including odema, arthritis, cardiovascular disease and so many others, is closely related to their
86 biochemistry in metabolism. The very long chain polyunsaturated fatty acids (C_{18}, C_{20} and C_{22}) as another
87 separate group, were discovered as having beneficial effects on health. Among these very long chain
88 polyunsaturated fatty acids, Linoleic acid (LA), was the first identified Essential Fatty Acid (EFA)[18:2 (n-6
89 omega)], whereas, α-linolenic acid [18:3 (n-3 omega)] is the other EFA as the long chain polyunsaturated.
90 These two EFAs are the only sources for important longer chain fatty acids and for synthesis of complex lipids
91 such as prostaglandins; dynamic but short lived compounds that control blood vessels and other body functions.
92 Arachidonic acid (C_{20})(AA), a member of the n-6 PUFA (or n-6 s), is another source of prostaglandins (PG).
93 Eicosapentaenoic acid(C_{20})(EPA), α-linolenic acid(LN) and Docosahexaenoic acid(C_{22})(DHA) EFAs are called
94 3 PUFAs (3 Polyunsaturated Fatty Acids) or n-3 omega PUFAs(n-3 series). In addition, dietary LN can be
95 converted to the EPA and DHA(**Warriss, 2001**). AA, LN and LA, long chain and higly unsaturated fatty acids
96 are "truly essential", while C_{18} compunds; stearic and palmitic acids, rich in animal fat, should be considered as
97 "conditionally essential"(**Trautwein, 2001**).

98

99 **Metabolic pathways of omega PUFAs:**

100 Conventional lipid emulsions relatively rich in n-6 omega PUFAs(LA and AA)lead to an increased
101 dienoic prostaglandin E_2 (PGE_2), thromboxane and leukotriene production as a result of the AA breakdown in
102 metabolism. PGE_2 production from AA is catalysed by a key membrane bound enzyme, Prostaglandin
103 endoperoxidase synthase (Pghs). Two types of Pghs, PgHs-1 and Pghs-2, form PGH_2 as the precursor of
104 thrombaxane A_2(TxA_2), responsible for vascular permeability, platelet aggregation and odema(**Kramer et al.**
105 **1996**: **Tapiero et al. 2002**). PGE_2, thromboxanes (especially thromboxane A_2) and leukotrienes are responsible
106 for their immunosuppressive properties and for the generation of free oxygen radicals. Briefly, inflammation and
107 thrombogenesis rates of the metabolism are mainly caused by n-6 PUFAs (LA and AA). In contrast, emulsions
108 rich in EPA, LN and DHA (n-3 omega PUFAs) inhibit the breakdown of AA, which is produced by the synthesis

109 of PGE_2(Fig. 1). This group produces PGE_1, PGE_3 and PGI_3 as trienoic PGs, thromboxane A_3 and pentaenoic
110 leukotrienes (e.g. LTB_5)(**Trautwein 2001**). PGD_2, which is produced by PGE_1, is also a sleep inducer, whereas
111 PGE_2, produced by n-6 omega PUFAs has an awakening effect(**Yehuda, Rabinovitz and Mostofsky, 1999**).
112 PGE_1, E_3 and I_3 inhibit the inflammatory reactions, as opposed to PGE_2 , while thromboxane A_3 decreases
113 platelet activation and thrombogenesis rate as opposed to thromboxane A_2 which is produced by n-6 omega
114 PUFAs(Fig. 1). Therefore, n-3 omega PUFAs always lower the risk of inflammation and thrombogenesis, caused
115 by n-6 omega PUFAs (**Nitenberg and Raynard, 2000**). Dietary LN is rapidly converted to another n-3
116 omega(dihomo α-linolenic acid), which can also be converted to n-6 AA.

117 Since AA is the precursor of inflammatory 2-series eicosanoids such as PGE_2, cytokines [interleukin-
118 1(IL-1), interleukin-2(IL-2, interleukin-6(IL-6)], and dihomo α-linolenic acid is the precursor of
119 antiinflammatory 1-series eicosanoids(Fig. 1) such as PGE_1(**Yehuda, Rabinovitz and Mostofsky, 1999; Endres
120 et al. 1989**), not only the ratio of AA to dihomo α-linolenic acid or LN, but also the conversion rate of these
121 fatty acids to each other, will be the initial factor in determining the inflammation prognosis of the
122 metabolism(**Belluzzi, 2001**). Dihomo α-linolenic acid and LN(as n-3 omega PUFA) also inhibit inflammation by
123 reducing the production of inflammatory PGE_2, leukotriene B_4(LTB_4), IL-1, IL-2 and IL-6(**Baker, Krauker and
124 Laposata 1989** and **Santoli et al. 1990**).
125
126 **Diseases and questions to be highlighted and n-3 omega PUFAs:**
127 Followed by n-3 omega supplementation and storing, a significant decrease in TNF(Tumor Necrosis
128 Factor) and an increase in T-suppressor cells take place(**Simopoulos et al. 1991**). Also, all these
129 antiinflammatory properties of n-3 omega PUFAs, are used in many inflammatory properties such as
130 Inflammatory Bowel Disease (IBD), eczema, psoriasis and rheumatoid arthritis. Similarly, an increase in n-6
131 omega PUFAs and a decrease in n-3 omega PUFAs raise the rate of occurrence of chron's disease(inflammation
132 of colon). Inhibition of the proinflammatory cytokine synthesis by n-3 omega PUFAs. can therefore be
133 beneficially used in the treatment of chron's disease(**Griffiths 1998**). Treatment of such diseases with n-3 omega
134 PUFAs, also reduces mucosal damage caused by inflammation, such as the mucosal damage of intestine in
135 enterit or mucosal damage of colon in chron's disease. **Stenson et al.** (1992) and **Hawthorne et al.** (1992)have
136 treated ulcerative colitis with first 5.4 and then 4.5 g of n-3 omega PUFAs(fish oil) and observed significant
137 healing on colon mucosa. Leukotriens as proinflammatory mediators which worsen the prognosis in major

surgery, leading to post traumatic immune dysregulation, can also be taken under control with n-3 omega PUFA supplementation in postoperative period. This, also makes n-3 omega PUFAs important antiinflammatory agents of postoperative periods(**Köller et al. 2003**). The administration of n-3 omega PUFAs ameliorates the host defense mechanisms with controlled inflammatory response(**Braga et al. 1998**), not only in postoperative but also in the preoperative periods.

Along with their beneficial effects, Omega 3 PUFAs have one notable side effect, oxidation(**Nardini et al. 1995**), which necessitates the regular use of an antioxidant, commonly Vitamin E(**Gil 2002; Linseisen et al. 2000; Arkhipenko and Sazontova, 1995**). Using such an antioxidant, can easily lower the excessive oxidation rate, caused by these fatty acids(**Puiggros et al. 2002**). The conjoint use of n-3 omega PUFAs and Vitamin E(α-tocopherol) after abdominal surgery, protects patients against inflammation in postoperative period, without increasing lipid peroxidation(**Linseisen et al. 2000**).

Fig. 1

Despite the substantial amount of knowledge related to the antiinflammatory and sleep promoting effects of n-3 omega PUFAs, the minimum effective doses have not been sufficiently determined. Establishing such correct doses will require a considerable amount of time and research, due to the spontaneous Omega 3 and Omega 6 fatty acid conversions to each other in metabolism and the differences in each person's unique serum Omega profiles.

Fig. 2

The ergogenic potential (**Emmanuel and Hubbard, 1993**), has not yet been brought out because of the lack of studies related to their use as energizers in sports and postoperative periods.

Oxygen free radicals (OFR) are very effective in the development of hypercholesterolemic atherosclerosis, resulting from excessive cholesterol on the entima layer of blood vessels. IL-1, LTB_4 and TNF as end products of PGE_2, stimulate polymorphonuclear leukocytes and monocytes to produce OFR. The n-3 omega PUFAs reduce the production rate of OFR by inhibiting the production of IL-1, LTB_4 and TNF(Prasad, 1997). While doing this(Fig. 1), on the other hand, they are very susceptible to the oxidation themselves. For example, the long term treatment at a high dose(7,7 g/day)of these fatty acids, also causes an increase in lipid peroxidation. Thus, the risk of this oxidation on plasmic membranes of red blood cells, should be considered as a serious side effect in nutrition with n-3 omega PUFAs(**Bartoli et al. 1995**). Similarly, incorporation of long-chain n-3 omega PUFAs in low density lipoprotein (LDL), induces a decrease in its resistance against oxidation because of their high degree of unsaturation of these fatty acids. A study conducted on rats, indicates a decrease

169 in plasma antioxidant potential and an increase in the susceptibility of LDL to oxidation(**Nardini, 1995**).
170 However, another study conflicts with this result, indicating no difference from the point of LDL particle
171 susceptibility to the oxidation between n-3 omega supplemented group and placebo(**Brude et al. 1997**). This
172 brings us a question of n-3 omega PUFAs from the point of oxidation phenomen. Are they oxidants or
173 antioxidants? Which one dominates the other? Is it the ratio of the reduction in the production rate of OFR by
174 inhibiting the production of IL-1, LTB_4 and TNF, or the ratio of oxidized n-3 omega free radical end products, or
175 the adverse effect of n-3 omega PUFAs on LDL particles. The only obvious conclusion here is, the necessity to
176 use n-3 omega PUFAs with moderate amounts of antioxidants in nutrition, which can also protect LDL from
177 oxidation.

178 Besides the antiinflammatory effect of n-3 omega PUFAs, the other beneficial and protective effect of
179 these fatty acids is on the cardiovascular system. Trans fatty acids, cholesterol and saturated fats are mainly
180 responsible for atherosclerosis. On the contrary, n-3 Omega polyunsaturated fatty acids are beneficial in
181 reducing cholesterol and the risk of myocardial infarction(**Zyriax and Windler, 2000**). Today, the science of
182 food and nutrition, also has the function of researching and unveiling the relation between nutrition and people
183 so that people can use nutrition to protect themselves from diseases or take them under control by reducing their
184 adverse effects. Just as the close relation between 'selenium, carotenoids and cancer' 'diatery fat and obesity'.
185 dietary sodium and hypertension', 'alcohol and stroke'have been proven, the close link betwen omega 3 PUFAs
186 and cardiovascular disease is now widely accepted. (**Temple 2002**). The best prevention of cardiovascular
187 diseases appears to be replacing saturated fats with n-3 omega PUFAs (**Temple 1996**). As previously mentioned.
188 eicosanoid synthesis by n-3 omega PUFAs minimizes the production of PGE_2 and thromboxanes(Fig. 1).
189 Especially, minimizing the production of thromboxanes by n-3 omega PUFAs protects the metabolism, and
190 especially cardiac tissue from clot formation, platelet aggregation and thrombosis risk(**Arkhipenko and**
191 **Sazantova, 1995**; **Wahlqvist 1998**). Not only suppressing clot formation and minimizing thrombosis risk and
192 fibrilation, but also lowering total cholesterol is another beneficial protective effect of n-3 omega PUFAs on
193 cardiovascular system(**Kusunoki et al. 2003**). Daily supplementations of 3 to 5.4 g EPA can decrease serum
194 cholesterol while slightly increasing high density lipoprotein (**Lox 1990**; **Reterstol et al. 1996**).

195 Although most studies define n-3 omega PUFAs as cholesterol and LDL reducers, a few studies
196 underline the increasing effect of LDL in long term use. For example **Schacky et al. (1999)** determined a 7%
197 increase in LDL, following a period of 2 years during which subjects consumed 3 g of EPA & DHA daily.
198 Similarly, 3g/70 Kg/7day use of EPA&DHA, was shown to lower the amount of VLDL(very low density

199 lipoprotein), while enhancing the capacity of LDL. The decrease in VLDL and increase in LDL seem to be due
200 to the conversion of VLDL to LDL by the activity of heparin lipases, activated by n-3 omega PUFAs(**Lu,**
201 **Windsor and Harris, 1999**). However, despite this increase, Schacky et al(1999) found a slight mitigation of
202 the atherosclerosis progress. The cholesterol reducing and high density lipoprotein increasing effect of n-3
203 omega PUFAs, makes them one of the most effective and competitive substances in the prevention of
204 atherosclerosis, similar to niacin, statins, fibrates etc. (**Rader 2003; Barbeau et al. 1997**). n-3 omega PUFA
205 supplementation of the diet has also been seen to lower the blood pressure in rats(**Yahia et al. 2003**). Similarly,
206 n-3 omega rich rapeseed oil supplementation has also a reducing effect on cholesterol and ratio of LDL to
207 HDL(**Eder and Brandsch 2002**). This beneficial effect of n-3 omega PUFAs has attracted the attention of the
208 humankind of the new milenium, because cardiovascular disorders are one of the most common total disesaes.
209 This protective effect is so significant that it has even begun to be used by aerodynamic industry to protect
210 cardiovascular systems of astronauts against abnormal and extraordinary oxidative stress of space(**Turner et al.**
211 **2002**).

212 The protective effect of n-3 omega PUFAs on cardiovascular system, can easily be increased by niacin,
213 bile acid resins, sport and exercise, which highlights the importance of life style and nutrition on health.
214 Similarly, increased intakes of marine n-3 omega PUFAs can result in decreased triglyserides, fibrinogen and
215 platelet aggregation, which are considered to be beneficial for cardiovascular diseases(**Allman et al. 1996**). The
216 higher serum triglyseride, cholesterol levels and high risk of cardiovascular diseases, inspected in Japanese
217 students, following their moving to the USA, can be compared with the lower tryglyseride and cholesterol levels
218 of the general population of Japan, is a clear example, showing the significance of n-3 omega fatty acids as
219 cardio protectors(**Sweeney et al. 1999**). n-3 omega PUFAs were added to bread, as it is the most commonly
220 consumed food product, and this enrichment lowered serum triglyseride level and also total serum cholesterol by
221 increasing HDL(**Liu, Wallin and Saldeen, 2001**). Also, inhibition of 'protein kinase C' enzyme and increase in
222 nitrozooxide(NO) release by n-3 omega PUFAs which inhibits platelet adherence to the collogen, also ease
223 blood circulaton(**Schoene 2001; El-seweidy et al. 2002**). Thus, supplementation of diet with n-3 omega PUFAs
224 is very effective and protective against cardiovascular diseases, such as hypertension and atherosclerosis(**Shoda**
225 **et al. 1996; Temple 2002**) and even in the reduction of the incidence of sudden cardiac death(**Villa et al. 2002**).
226 n-3 omega supplementation of the diets in rats, decreased mortality rate, caused by myocardial infarction(MI)
227 while decreasing creatin phosphokinase as the indicator for MI. On the contrary, increased mortality rate was
228 observed when the rat diets were supplemented by saturated fat of coconut oil(**Nageswari, Banerjee and**

229 Menon 1999). Greenland Eskimos have a substantially lower rate of acute myocardial infarction when compared
230 with Western people. With our present data mentioned above, we can note this cardioprotective effect of n-3
231 omega PUFAs. According to **Lee and Lip(2003)**, the use of these fatty acids should be considered as part of a
232 comprehensive secondary prevention strategy in post-myocardial infarction. Similarly, ischemia-induced
233 aryhthmias can be prevented by n-3 PUFA supplementation, perhaps with an ion exchange mechanism; however
234 this is a hypothesis(**Leaf et al. 2003**). In spite of many studies, indicating the protective effect of n-3 omega
235 PUFAs on cardiovascular system, the minimum dose which shows this effect was not established until **Weber**
236 **and Raederstorff(2000)**. According to them, 1 g/day n-3 omega(as in fish oil)application is sufficient to show
237 this serum triglyseride and LDL lowering effect, while 3 g daily intakes of EPA and DHA are generally
238 regarded as safe by Food and Drug Administration(**O'Keefe, JR. and Harris 2000**). On the other hand,
239 insufficiency of n-3 omega PUFAs and high amounts of n-6 omega PUFAs, may also increase the atherogenic
240 effects of environmental chemicals such as polychlorinated biphenyls(PCB), leading to dysfunction of the
241 vascular endothelium. The effect of Linoleic acid or (PCB) is opposite to that of n-3 omega PUFAs, distrupting
242 endothelial barrier function. Furthermore cellular enrichment with linoleic acid can amplify PCB induced
243 endothelial cell dysfunction, which brings about a cardiotoxic effect(**Slim et al. 2001**). These findings underline
244 the importance of n-3 omega PUFAs as a cardioprotecter especially for individuals living in cities.

245 Although there is a significantly important protective effect of n-3 omega PUFAs on cardiovascular
246 system and an inhibitory effect on inflammation, the cardioprotective effect of these fatty acids is also dependent
247 on their antiinflammatory properties. The antiinflammatory properties of n-3 omega PUFAs are due to the
248 incorporation of EPA and DHA in cell membrane. The NADPH oxidase, the main structural component of cell
249 membranes, consisting of six components, three of which exit in the cell membrane. is activated by n-3 omega
250 PUFAs. Only after this activation, do these components join the cell membrane structure and make it more
251 durable. This long lasting quality of cell membranes, activated by n-3 omega PUFAs. is a plus for the cell for its
252 protection against extrinsic and intrinsic destructive factors, especially inflammatory agents. This protection
253 against inflammation is of course the same for the cells of vessels and heart(**Heine et al. 1999**).

254 The strength of the cells due to the n-3 omega incorparation also shows its beneficial effect on brain
255 cells. The antiinflammatory and cardioprotective functions of n-3 omega PUFAs improve the immune system.
256 This improvement is very important for the immune system diseases such as HIV/AIDS, which requires
257 nutrients to power the immune system and support maximum cellular protection and function for long term

258 survival. It can be clearly expressed that, n-3 omega PUFAs have a potential as an immun system defender and
259 enhancer in immune system deficiencies in the nutrition of today and the near future(**Zimmerman 1997**).

260 Diabetes, remarkably increases plasma glucose, fructosamine, triglyseride, LDL and decreases HDL. It
261 also enhances oxidative markers like oxidative susceptibility of LDL, catalase activity and NO
262 (nitrozooxide)levels, while increasing the synthesis and release of cytokines(IL-1 and TNF). Treatment of
263 diabetic rats with n-3 omega PUFAs, have been seen to reduce LDL markedly, plasma triglyseride and cytokine
264 synthesis(**El-seweidy et al. 2002**). One of the very few studies related to the 'serum glycogen level and n-3
265 omega intake determined lower glycogen concentrations in n-3 omega fed rats, when compared with casein fed
266 rats(**Gavia et al. 2003**). We need more studies to highlight the sugar lowering effect of n-3 omega PUFAs in
267 human serum profile but this study and the previously mentioned one, may be taken into consideration when
268 evaluating the sugar lowering and hazard-reducing effects of these fatty acids in the treatment of Diabetes in the
269 near future.

270 n-3 omega PUFAs are also used for the treatment of diseases in gastrointestinal origin. Especially, the
271 stimulation of PGE_1 secretion by n-3 omega PUFAs by decreasing platelet aggregation(**Levy and Herzberg**
272 **1996**).

273 Like cardiovascular diseases, one initial predisposed factor of cancer, appear to be the fat composition
274 of the diet. Whereas an increased ratio of saturated fatty acids in the diet leads to cancer, many researchers have
275 determined the protective effect of eicosanopentaenoic acid in diet against cancer of gastrointestinal origin.
276 Increased concentrations of long chain fatty acids and eicosanopentaenoic acid (as the main substances of n-3
277 omega PUFAs) protect the metabolism against colorectal cancer (**Nkondjock et al. 2003**). The oral
278 supplementation of n-3 omega PUFAs show beneficial effects in patients with pancreas cancer, by decreasing
279 tumor formation(**Gogos et al. 1998**) and reducing weight-loss(**Barber et al. 1999**). Fish oil, soy bean and fish
280 oil combined supplementations of diet showed an increase in body weight in a study on rats, indicating their
281 potential for weight gain in cancer(**Gavia et al. 2003**). n-3 omega fatty acid supplementation is very effective.
282 not only as an antitumor agent but also in mediating the effects of nutritional interventions by prolonging life
283 span, suppressing autoimmune diseases and decreasing tumorigenesis (**Troyer and Fernandes, 1996**). Unlike
284 the significant protective and suppressing effects of n-3 omega PUFAs on cancer and autoimmune diseases, n-6
285 omega PUFAs increase the risk of tumor promotion, indicating the necessity to prefer olive and canola oils.
286 which are low in n-6 omega(**Wood, Spark and Spark, 1996**). A 30 g daily supplement of flaxseed which is a
287 rich source of lignin and n-3 omega PUFAs along with fat restriction in the diet, decreased prostate specific

antigen level and proliferation rate in prostate cancer(**Denmark-Wahnefried et al. 2001**). The data mainly related to the protective effect of n-3 omega PUFAs against cancer is mainly determined by these factors: the type of the cancer, metabolism, genes, sex, age and diet. Whereas n-3 omega PUFAs show their protective effect against cancer on metabolism, high dietary linoleic acid(as n-6 omega PUFAs) intake can elevate oestrogen levels in pregnancy, altering mammary gland morphology and expression of fat-and/or estrogen-regulated genes and increasing breast cancer risk (**Clarke, Clarke and Lippman**, 1999).

Phospholipids make up 60% of the dry weight of the brain. The increase in phospholipid concentration of brain cell membranes has a significantly beneficial effect on the treatment of schizophrenia(**Horrobin et al. 2002**). Phospholipids are also essential for neuronal and especially for synaptic structure and play a key role in the signal transduction responses to dopamine, serotonin, glutamate and acetyl choline. n-3 omega PUFAs, by controlling the overactivity of T-cells and antiphospholipid antibodies may be effective in decreasing the severity of major depression(**Maes et al.** 1993). On the other hand, the inflammatory processes mentioned above, may influence levels of neurotransmitters, especially by decreasing serotonin. n-3 omega PUFAs, by enhancing the production rate of serotonin, can also reduce the severity of depression(**Song et al. 1998; Maes et al** 1997). In the cases of depression, there are abnormally low amounts of omega 3 PUFAs and eicosapentaenoic acid while excessive amounts of omega 6 PUFAs are seen. The unsaturated fatty acid components of phospholipids are abnormally low in depression, with deficits of eicosapentaenoic acid and other n-3 omega PUFAs and excesses of the n-6 omega(arachidonic acid). According to **Hibbeln** (1998), the prevalence of depression is inversely related to the amount of fish consumed. Similarly a decreased ratio of n-3 omega fatty acids to n-6 omega fatty acids in the plasma and erythrocytes of patients with major depression, and decreased n-3 omega fatty acid concentrations in erythrocytes, have also been associated with increased severity of depression (**Edwards et al. 1998; Peet et al. 1998**). Also, lower DHA content in mother's milk and lower seafood consumption are associated with higher rates of postpartum depression(**Hibbeln 2002**), which indicates another importance of n-3 omega PUFAs in the prevention of postpartum depression. Unlike n-3 omega PUFAs, which decrease cytokine production and depression, n-6 omega PUFAs increase cytokine production and therefore, may be hazardously effective by stimulating depression. On the other hand, cardiovascular diseases, immunological activation, cancer, diabetic complications and osteoporosis are some of the metabolic disorders leading to depression or associated with depression. By protecting metabolism against cardiovascular diseases, inflammation, cancer and diabetes, n-3 omega supplementation also appears to have the function of reducing the risk and severity of depression which is often associated with the above mentioned disorders(**Horribin 2001**).

318 In the case of Alzheimer's disease(AD), various genetic, medical and environmental factors appear to
319 be causative. The risk of AD increases, when one of these factors leads to a cerebral perfusion, which causes an
320 insufficient flow of blood to the brain. Not directly, but in an indirect manner, the beneficial effects of n-3 omega
321 PUFAs can decrease the risk of AD by easing the flow of blood in the brain and central nervous
322 system(**Heininger 2000**).

323 The omega 3 PUFAs supplementation in the diet of the mother during the first 42 days of the lactating
324 period also improves psychomotor development and birthweight significantly(**Woltil et al. 1999**). On the other
325 hand, n-3 omega PUFAs improve protein metabolism and do not cause negative nitrogen balance which is
326 always caused by n-6 omega PUFAs(**Hayashi et al. 1999**). Therefore, n-3 omega PUFAs have a potential for not
327 only protecting mothers against postpartum depression mentioned above, but also enhancing the wellness of
328 new-borne infants. According to **Morley(1998)**, although related studies have some methodological problems
329 and conflicting results, a dietary supply of DHA, either in breast milk or in a supplemented formula, may be
330 closely linked to a better cognitive development in the newborne infant.

331 The primary sources of n-3 omega, are some algae and fungi from Mucorales order(**Bajpai and Bajpail**
332 **1993**), Ooligan grease (Thaleichthys pacifus)(**Kuhnlein et al. 1996**), Camelina sativa L. Crantz seed (**Rokka et**
333 **al. 2002**) and Sea/fresh water fish, vegetable and oil products ((**Sauci., Fahman and Kraut. 1994**) which are
334 also shown in Table 1.

335 **Table 1**

336 Contrary to preconceived opinions, EPA(Eicosapentaenoic acid) and DHA(Docosahexaenoic acid)(as
337 the precursors of n-3 Omega's)contents alone have no significant meaning in the evaluation of the omega quality
338 of fish and marine products, since Arachidonic acid(AA) and EPA, DHA, LN can be converted to each other in
339 the metabolism. Therefore, in the nutritional evaluation of Omega quality of the concerned foods, the ratio of
340 total fat content to the amount of EPA and DHA should be considered and examined rather than the DHA and
341 EPA contents alone. This ratio should be as small as possible, just as in halibut, cod, haddock and tuna(Table 1).

342 Similar to the faulty evaluation of the fish omega quality, the omega quality of oils are also wrongly
343 evaluated. α-Linolenic acid(LN) and Arachidonic acid(AA) do not mean anything by themselves, since they can
344 be converted to each other in the metabolism. Therefore, the ratio of total fat content to the total amount of α-
345 Linolenic acid should be considered as the main criteria in determining the omega quality of oils(Table 1).

346 The prognosis of the treatment with n-3 omega PUFAs is closely related to the type of the fatty acid
347 form. Pure EPA supplementation in ethyl ester form always has greater effect than fish oil due to easier

348 absorption through intestinal wall without requiring lipase. Especially platelet reactivity is more limited by pure
349 EPA supplementation of the diet when compared with fish oil extract(**Wojenski, Silver and Walker 1991**).

350 The importance of n-3 omega PUFAs in the treatment and inhibition of important diseases has made
351 them one of the most important food additives in food industry. The oxidation risk of meat products enriched
352 with n-3 omega PUFAs, appeared to be one of the problems faced by the food industry and some research has
353 been conducted by the meat scientists. While **O'Keefe, Proudfoot and Ackman(1995)** determined high
354 peroxide values during refrigeration in poultry fed with 8 and 12% fish meal, supplementation of the diet with
355 fish oil (as n-3 omega source) was not effective on color criteria and oxidative stability of lamb during
356 refrigeration, according to **Ponnampalam et al.(2001)**. These results seem to be far from highlighting oxidative
357 stress due to n-3 omega supplementation of the foods but what we definitely know is the necessity to use n-3
358 omega PUFAs as combined with fat soluble antioxidants, not only in human metabolism but also in meat and
359 meat products. Following this thread of thought, hopefully, meat producers and meat scientists will include
360 omega 3 food additives to meat, meat products and animal feed with an antioxidant.

361 Unfortunately, there seems to be no study related to the effects of n-3 omega intake on bone&skeleton
362 health. Only one study, carried out by **Sirois, Cheung and Ward(2003)**, determined no difference in the
363 vertebrae of male rats, fed with n-3 omega PUFAs, while this supplementation had reduced the growth in height
364 and vertebral peak load in females. More investigation is required to highlight the effects of n-3 omega PUFAs
365 on human bone&skeleton, bone&vertebrae strength and susceptibility to fractures.

366 **Fig. 3**
367
368 **Questions, questions....**
369
370 When all the above-mentioned studies are taken into account, n-3 omega PUFAs may be accepted as
371 clearly beneficial food supplements, especially with their protective effect on cardiovascular system.
372 Unfortunately, there are still some important questions, to be illuminated. While the beneficial effects of n-3
373 omega PUFAs on metabolism such as reducing the risk of cancer, cardiovascular diseases(esp. atherosclerosis),
374 many inflammatory disorders (such as ulcerative colitis, chron's disease, asthyma etc..), diabet, depression and
375 even Alzheimer, the minimum effective dose for each of these diseases and also for each individual patient, has
376 yet to be determined. The unique metabolism of each person has different serum DHA and EPA levels, which
377 depend on metabolism, genetic character and nutritional habits. Under these circumstances, the dose given to the
378 person, in tablet or in food form, may be excessive or insufficient. This point strongly requires the standard

379 determinations, indicating which patient serum DHA and EPA levels should be supplied by what amounts of
380 DHA&EPA levels in food.

381 My aunt, who was under treatment for brain emboly in a hospital in Atlanta/Georgia, was given the
382 anticoagulant, Coumadin, while at the same time, weekly diet programs were constructed, taking the omega 3
383 content of the foods that she consumed and the protrombin (Ptz) time (a criteria for determining the clotting
384 level of blood) due to Coumadin amount, into consideration. When trombin time increases, in other words, when
385 there is an excessive anticlotting due to overdose of Coumadin, the personnel served foods, low in Omega 3,
386 during the same week. On the other hand, in cases of Coumadin insufficiency which results in high levels of
387 coagulation in the blood(which is confirmed by short time of protrombin), the personnel served omega 3-rich
388 foods. I was greatly schocked to learn of this regular practice in the U. S. A., because my mother at that time,
389 was also hospitilized for the same disease in a Turkish hospital before she died. In my mother's case, dietary
390 intake was not determined according to omega 3 contents during Coumadin treatment. What I want to strongly
391 emphasize, is the necessity to standardize these procedures in all cardiovascular and neurological departments in
392 all hospitals all over the world by determining 1)not only protrombin times but also 2) Coumadin dose, and
393 importantly, 3) dietary intake according to omega 3 levels.

394 What about the minimum effective omega 3 dose?. According to the world's most widely accepted
395 FAO/WHO, the recommended dose is 5-10:1(n-6/n-3)(Trautwein 2001). But this dose has not been established
396 by taking different serum DHA&EPA contents of different metabolisms into account. It should be noted that
397 there seems to be no study related to the serious side effects(like the risk of internal bleeding). that arise from the
398 excessive intake of n-3 omega PUFAs. There is no doubt about their beneficial effects on the metabolism. We
399 can even consider and define them to be one of the miracles of today's nutrition but first of all. we should bring
400 to light which n-6/n-3 ratios affect human metabolism beneficially. It has been established that, only lower
401 ratios between 2.5:1(n-6/n-3) and 5:1(n-6/n-3), are beneficially effective. 2.5/1(n-6/n-3)daily intake has been
402 proven to be beneficialy effective on colorectal cancer, 2-3:1(n-6/n-3)intake on rheumatoid arthritis, and 5:1(n-
403 6/n-3) on asthma. Interestingly, 5-10:1(n-6/n-3)intakes, recommended by FAO/WHO have been proven to have
404 adverse effects on metabolism(**Simopoulos AP, 2002**).

405 What is the situation related to the side effects of n-3 omega PUFAs such as fattening of mucosa, the
406 risk of internal bleeding or their unfavorable interaction with other food ingredients.? In spite of the lack of
407 knowledge in the above-mentioned items, we still continue to use omega 3 supplements to decrease the mortality

rate of some hazardous diseases without control. This leads to serious side effects like bleeding from excessive intake of n-3 omega or thrombosis and emboly from excessive intake of n-6 omega.

Conclusion:

Allthough there are still some important questions awaiting answers about n-3 omega PUFAs, the clear and definite point is the beneficial effects of n-3 omega PUFAs on the metabolism. Unfortunately, scientific data is not sufficiently reflected to technology. There are still not many meat products(except jambon) or cosmetics, enriched with omega 3 PUFAs on the market. Taking into account the cholesterol and sugar reducing effects of omega 3 PUFAs, the meat industry should enrich their meat products with these fatty acids. In some of the studies related to the enrichment of meat and meat products with n-3 omega PUFAs, linseed oil, forages(rich in linolenic acid) and fish meal were used as the feed ingredients for beef, mutton and pork, during the period before slaughter(**Raes, Smet and Demeyer, 2003**).However, there have been no studies on serum cholesterol and n-3 omega levels following the consumption of these meats rich in n-3 omega. After such studies have been performed, n-3 omega PUFAs might become the basic anticholesterolemic meat additives of meat industry. Based on **Levy and Herzberg's (1996)** claim that omega 3 supplementation inhibits platelet aggregation, can we assume that the same supplementation will ease bile flow and therefore assist the treatment of renal failure?. In order to find the answer to this question, new research has to be conducted in the field of nephrology.

In spite of the many studies mentioned above, very interestingly and unfortunately, **O'Keefe, Proudfoot and Ackman, 1995** and **Ponnampalam et al, 2001**, determined high peroxide amounts or no change, following omega 3 supplemented feeding of poultry and mutton, which conflicts with other studies showing the antioxidant effects of omega 3 fatty acids. What are these n-3 omega PUFAs?. Are they oxidants increasing peroxide in meat products, or antioxidants.?

To conclude, in order to rightfully define these fatty acids as the miracles of today's nutrition, studies related to their use; a)in renal failure, b)in sport c)as cholesterol reducers and as new meat additives d)in treatments with Coumadin and other anticoagulants e)in bone&skeleton health, and f)in neurological disorders, after determining the correct n-3/n-6 omega PUFA ratios, are strongly needed to be conducted.

441
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677 FIGURES

678

679 1. Biochemical pathways of Omega fatty acids with their effects on metabolism.

680 2. The roles of Omega fatty acids in disease formation.

681 3. The deseases and fields, beneficially effected and controlled by Omega 3 fatty acids.

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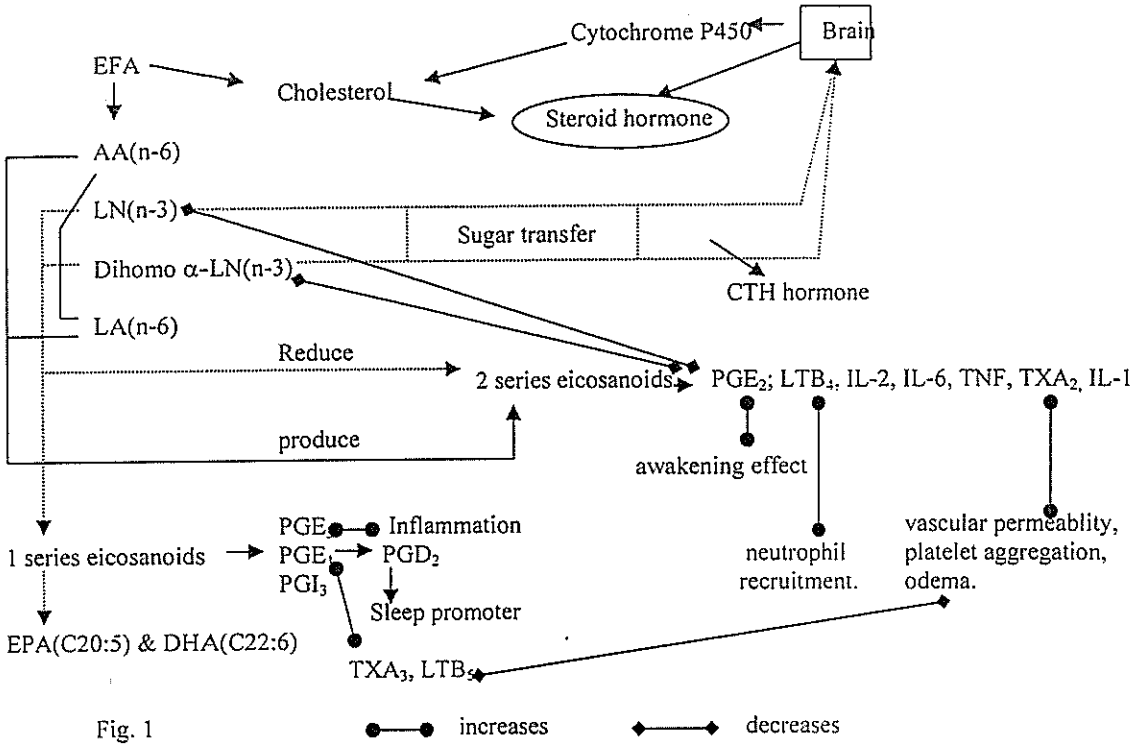

Cytochrome P450
Brain
EFA
Cholesterol
Steroid hormone
AA(n-6)
LN(n-3)
Sugar transfer
Dihomo α-LN(n-3)
CTH hormone
LA(n-6)
Reduce
2 series eicosanoids
PGE2; LTB4, IL-2, IL-6, TNF, TXA2, IL-1
produce
awakening effect
PGE1
Inflammation
1 series eicosanoids
PGE1
PGD2
PGI3
neutrophil recruitment.
vascular permeablity, platelet aggregation, odema.
Sleep promoter
EPA(C20:5) & DHA(C22:6)
TXA3, LTB5
increases
decreases

Fig. 1

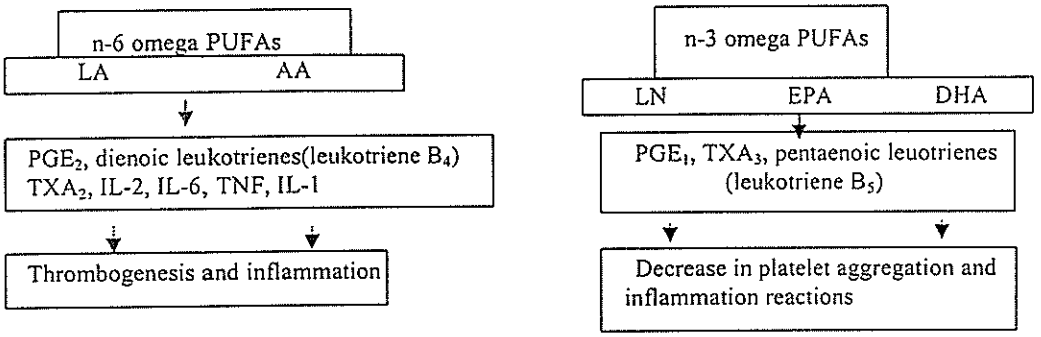

n-6 omega PUFAs
LA
AA
PGE2, dienoic leukotrienes(leukotriene B4)
TXA2, IL-2, IL-6, TNF, IL-1
Thrombogenesis and inflammation
n-3 omega PUFAs
LN
EPA
DHA
PGE1, TXA3, pentaenoic leuotrienes
(leukotriene B5)
Decrease in platelet aggregation and
inflammation reactions

Fig. 2

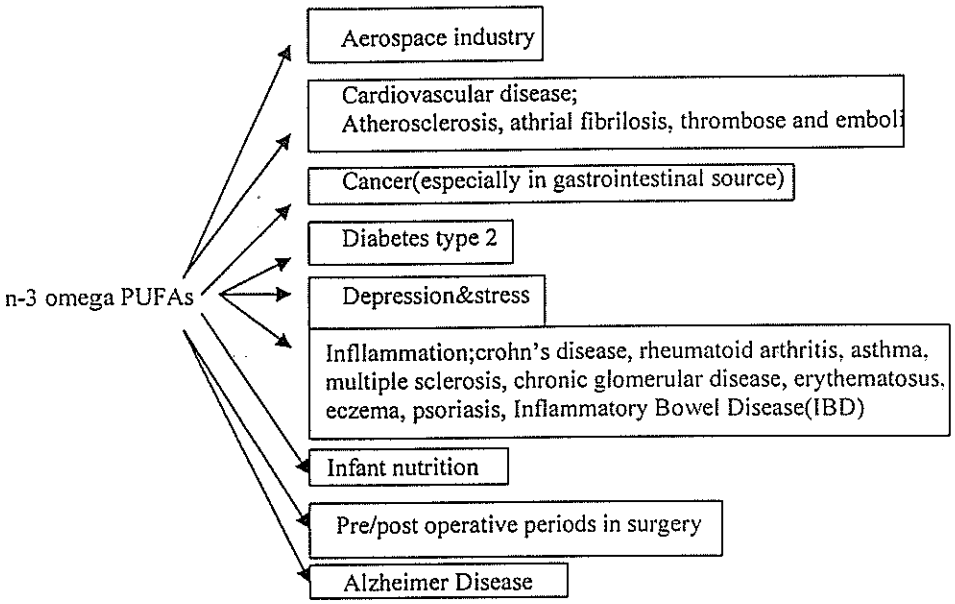

n-3 omega PUFAs
Aerospace industry
Cardiovascular disease;
Atherosclerosis, athrial fibrilosis, thrombose and emboli
Cancer(especially in gastrointestinal source)
Diabetes type 2
Depression&stress
Infllammation;crohn's disease, rheumatoid arthritis, asthma, multiple sclerosis, chronic glomerular disease, erythematosus, eczema, psoriasis, Inflammatory Bowel Disease(IBD)
Infant nutrition
Pre/post operative periods in surgery
Alzheimer Disease

Fig. 3

TABLES

1. Fat content/EPA+DHA(g/100g) and fat content/ α-linolenic acid(g/100g) ratio of various fish, marine products, vegetables and oils.

	Fat content(g/100g)	EPA+DHA(g/100g)	Fat content/EPA+DHA(g/100g)
Eel	24.5	0.83	29.51
Hering	17.8	2.72	6.54
Sprat	16.6	3.23	5.14
Tuna	15.5	3.37	4.60
Salmon	13.6	2.86	4.76
Mackerel	11.9	1.75	6.8
Carp	4.8	0.30	16
Sardine	4.5	1.39	3.24*
Swordfish	4.4	1.79	2.45*
Trout	2.7	0.59	4.58
Halibut	1.7	0.51	3.33*
Cod	0.6	0.18	3.33*
Haddock	0.6	0.16	3.75*
Lobster	1.9	0.20	9.5
Shrimp	1.4	0.30	4.66
Mussels	1.4	0.15	9.33
Anchovy	2.3	0.50	4.60
Sardine	13.9	2.44	5.70

	Fat content(g/100g)	α-linolenic acid(g/100g)	Fat content/ α-linolenic acid(g/100g)
Butter	83.2	1.20	69.3
Lard	100.0	0.98	102.04
Linseed oil	100.0	54.2	1.84
Soybean oil	100.0	7.70	12.98
Rapseed oil	100.0	9.15	10.93
Walnut oil	100.0	13.5	7.40*
Olive oil	100.0	0.86	625
Vegetable oil	80.0	2.40	33:3
Almonds	54.1	0.26	208.07
Hazelnut	61.6	0.15	410.6
Walnuts	62.5	6.80	9.19
Kale	0.90	0.35	2.57*
Lettuce	0.22	0.07	3.14*
Parsley	0.36	0.12	3.00*
Potato	0.11	0.02	5.5*
Cauliflower	0.18	0.10	1.8*
Spinach	0.30	0.13	2.31*
White cabbage	0.20	0.09	2.22*
Wheat bran	4.65	0.16	29.06