

Nutritional value of shrimp *vis-à-vis* meat and egg

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Focal Points at a Glance

This write-up, while it endeavours to establish superior nutritional value of shrimp compared to meat and egg, includes an observation: In spite of very low fat content of shrimp, the cardiologists suggest to avoid shrimp consumption due to its moderately high cholesterol content (150 mg%), but then the cholesterol content of shrimp is much lower than that of egg (400 mg%), and butter and ghee (300 mg%).

Nutrition and food supply are the cornerstones that determine the health and well being of all the people, both rich and poor. The worthy function of the food is to maintain health and optimal productive performance by providing all nutrients in adequate quantities so as prevent diseases and also to prevent chronic diet related disorders. Consuming a variety of foods in balanced proportions will ensure this objective of disease-free healthy life. Most of the non-communicable diseases are related to diet either directly or indirectly and more than 70% of global deaths are due to non-communicable diseases like coronary heart diseases (CHD) and *Diabetes mellitus* etc. The susceptibility of Indian population to CHD is 3-4 times more than Americans, 6-7 times more than Chinese and 20 times more than the Japanese and vascular ageing is 10 years advanced than the western population. The studies clearly indicate that one third of the Indian population has conditions conducive to the development of vascular diseases. The type and quantity of fat in the diet influence many of the life-style diseases and more particularly CHD along with other nutrients. The scientific evidences indicate that consumption of foods rich in ω -3 polyunsaturated fatty acids (PUFA) and in low saturated fatty acids (SFA) will reduce the deaths due to CHD. The increased consumption of seafood in western countries is due to this perception.

Nutritional quality of shrimp

Shrimp is one of the world's most popular shellfish and is part of almost every nation's traditional meal and its popularity has created a demand for its produce. This paper highlights nutritional value of shrimp. Shrimp provides high quality proteins and essential amino acids, minerals and trace elements, fat soluble vitamins and essential fatty acids including long chain ω -3 fatty acids for human body. Unlike the popular perception, shrimp is a low-fat (low-calorie) source of protein. Shrimp lipid contains mostly polyunsaturated fatty acids (essential fatty acids), which include linoleic acid and alpha-linolenic acid that are parent compounds of ω -6 and ω -3 acid series, respectively, which provide various health benefits to humans.

Shrimp contains about 20% protein with all essential amino acids in balanced proportions. 100g of shrimp

is considered to provide one third of one's daily protein requirement for an adult. Shrimp is a rich source of calcium, iron, zinc, iodine, phosphorus and selenium and it is a fact that these minerals are highly bio-available. Consumption of 100g of shrimp provides 100 mg of calcium and 300 mg of phosphorus meeting one third of these requirements of an adult human being. In addition, shrimp also contains 2 mg% of carotenoids, a fat soluble pigment known to play an important potential role in human health by acting as most potent biological antioxidant, protecting cells and tissues from the damaging effects of free radicals. Other health benefits of carotenoids that may be related to their antioxidative potential include enhancement of immune system function and inhibition of the development of certain types of cancers.

Shrimp is one of the lowest fat content non-vegetarian food item. The average lipid content in the edible



portions of shrimp is ~1%. Shrimp lipids differ greatly from mammalian lipids in that they include up to 40% of long-chain fatty acids (C14-C22) that are highly unsaturated and contain 5 or 6 double bonds. Intake of unsaturated fatty acids is better than saturated fatty acids as the later fatty acids stimulate body to synthesise more low density lipoproteins which is 'un-healthy cholesterol'. Fatty acids found in shrimp lipids are recognised by high degree of un-saturation (high proportions of long chain polyunsaturated fatty acids, PUFA), found in proportions of about 35-55 % in shrimp lipids. Also, the PUFA belong to the n-3 or ω-3 groups. Within PUFA, ω-3 fatty acids are predominant and n6/n3 PUFA ratio is 0.6-0.80 indicative of its rich health benefits to human being.

Higher ω-3 PUFA levels in cell membrane favourably alter the cardiac ion channel function and this in turn reduces myocardial vulnerability to myocardial fibrillation. The presence of high levels of the long-chained ω-3 fatty acids, eicosapentanoic acid (EPA) and docosahexanoic acid (DHA), are identified as one of the major benefits of ingesting fish and shellfish species. EPA is believed to play important roles in maintaining the health of heart and circulatory system, where as DHA are involved in the functioning of brain, nerves, etc.

Comparison of shrimp with meat and egg

Nutrient composition of shrimp and other meats and egg is presented in Table 1. The protein content is in the range of 16.90 to 21.35%. Lipid values are highly variable from 1.01 to 21.50%. Shrimp is a rich source of protein, calcium, trace minerals, vitamins and various extractable compounds like carotenoids. Shrimp is low in total fat (1 g/ 100g edible portion), and very low in saturated fatty acids and relatively high amounts of ω-3 fatty acids especially eicosapentanoic acid (EPA) and docosahexanoic acid (DHA), which have potential beneficial effects on preventing atherosclerosis and thrombosis. In spite of very low fat content in shrimp, the cardiologists suggest to avoid shrimp consumption due to its moderately high cholesterol content (150 mg/100 g shrimp). But the cholesterol content in shrimp is much lower than hen egg (400 mg%), liver

Table 1: Nutrient composition of shrimp, meat and egg (in percentage)

	Moisture	Crude protein	Ether Extract	Total Ash
Shrimp	76.63±0.672	20.64±0.614	1.01±0.044	1.16±0.030
Beef	55.45±0.322	18.66±0.331	21.50±0.443	0.91±0.049
Mutton	68.58±0.601	19.03±0.419	10.09±0.560	1.07±0.104
Chicken with skin	56.12±0.499	16.90±0.332	20.39±0.536	1.95±0.227
Chicken skin less	68.84±0.765	21.35±0.238	5.88±0.217	1.22±0.077
Egg	77.53±0.417	11.48±0.293	8.53±0.232	0.88±0.037

Table 2: Summary of Lipids of shrimp, meat and egg*

	SFA (g) [†]	PUFA ^{**} : SFA	ω-3/ω-6 PUFA	Cholesterol (mg%)	Atherogenic index
Dietary Guidelines	Higher SFA increases blood cholesterol	P:S of above 0.45 is recommended	The ratio of >0.2 is recommended	Should not be >300 mg (USA); 200 mg (India)	Lower the good for health ratio
Shrimp	0.25	1.20	1.50	150	0.24
Chicken	6.0	0.70	0.06	100	0.50
Mutton	7.0	0.13	0.73	65	1.00
Beef	8.0	0.12	0.53	70	0.70
Pork	13.0	0.53	0.13	90	0.67
Egg	4.0	0.40	0.20	400	0.40
Comments	Lowest in shrimp-good for health	Highest in shrimp-good for health	Highest in shrimp-good for health	Moderate in shrimp-but not harmful due to high P:S and ω3/ω6 ratio	Lowest in shrimp-good for health
<small>*Saturated Fatty Acids **Poly-unsaturated Fatty Acids</small>					

*data compiled from Ghafoorunissa and Kamala (2007); Enser et al., 1995, Chow (2008)

(300-600 mg%), brain (2000 mg%) and butter and ghee (300 mg%).

The effect of shrimp consumption on lipid profiles in humans was studied by systematic clinical trial. In a randomised study by De Oliveira-Silva *et al.* (1996), a diet containing 300g shrimp/day increased low-density-lipoprotein (LDL) cholesterol by 7.1% and high-density-lipoprotein (HDL) cholesterol by 12% when compared with a baseline diet matched for fat content but containing only 107 mg cholesterol/dl. At the same time, the shrimp diet did not worsen the ratio of total cholesterol to HDL cholesterol or the ratio of LDL to HDL cholesterol. Moreover, shrimp consumption decreased triacylglycerol (triglyceride) concentrations by 13%. The study showed that moderate shrimp consumption in normolipidemic subjects will not adversely affect the overall lipoprotein profile and can be included in 'heart healthy' nutritional guidelines. The nutritional significance of lipids of shrimp, meat and eggs are summarised in Table 2. In order to measure the propensity of shrimp eating to influence the incidence of coronary heart disease, the

atherogenic index was calculated based on Ulbright and Southgate (1991) equations. The atherogenic index of shrimp is 0.24 and it is much lower than other animal foods such as mutton (1.00), beef (0.7), pork (0.67), chicken (0.5) and similar to those of fin fish (Mackerel, 0.28) indicative of its cardio-protective nature.

Joint FAO/WHO Expert Consultation (2010) on the risks and benefits of fish including shellfish consumption, based on the strength of scientific evidences concluded that there is convincing evidence of beneficial health outcomes from fish consumption as indicated by reduction of cardiac deaths and improved cognitive developments in children. In addition, eating of fish has probable benefits in preventing ischemic stroke and possible benefits in reducing depression. The health benefits of eating shrimp is beyond ω-3 fatty acids and other individual nutrients. It is the complimentary effect of the combined nutrients present in shrimp including proteins, trace minerals and beyond those other non-nutrient factors like carotenoids. The expert advisories indicate that the health benefits far outweigh the risks due to

methyl mercury and dioxins. These risks are reported from fishes high in the food chain like the tunas, shark and king mackerel and are not a matter of concern in farmed shrimp. ICMR recommends 3 eggs/week in spite of high (400 mg %) cholesterol in view of its several nutritional advantages. The shrimp with its lowest fat, less cholesterol and high ω-3 PUFA content compared to egg, may also be recommended for regular platter.

References

CHOW, C.K. (2008) Fatty acids in

Foods and their Health Implications. CRC Press pp.1296

De Oliveira E SILVA, E. R., SEIDMAN, C. E., TIAN, J. J., HUDGINS, L. C., SACKS, F. M. AND BRESLOW, J. L., Effects of shrimp consumption on plasma lipoproteins. *Am. J. Clin. Nutr.*, 1996, 64, 712-717.

ENSER, M. K. HALLETT, B. HEWITT, G.A.J. FURSEY and J.D. WOOD (1995). Fatty acid content and composition of English Beef, Lamb and Pork at Retail. *Meat Science* 42: 443-456.

FAO/WHO (2010). Report of the

Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption. Rome. Food and Agriculture Organization of the United Nations; Geneva, World Health Organization, FAO Fisheries and Aquaculture Report No. 978. 50 pp.

GHAFOORUNISSA and KAMALA K. (2007). Diet and Heart Disease. National Institute of Nutrition, Hyderabad.

ULBRIGHT, T.L and D.A.T. SOUTHGATE (1991). Coronary heart diseases: seven dietary factors. *Lancet* 338 (8773): 985-992.

Prices of Various Fish feed ingredients as on 26 April 2013

The prices of fish feed ingredients collected from Andhra Pradesh are given below. It can be seen that in April the price of soya has gone up by a rupee and a half, and that of DORB has gone up by one rupee. However, Corn has gone down by a substantial margin.

Sampled Date	Jan-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13
		25-08-12	21-09-12	20-10-12	23-11-12	29-12-12	25-01-13	25-02-13	29-03-13	26-04-13
Price of Soy meal (per kg)	19	44	45	31	29.5	29	29	30.2	36	37.5
Price of Corn (per kg)	12	15	14.5	13.5	15	14.6	14.8	14.5	14.2	11.5
Price of DORB (per kg)	7	11	12	13.5	13.5	9.2	11	11	12	13
28 Protein index (calculated automatically as soymeal*0.45+corn*.25+dorb*0.25)	13.3	26.3	26.875	20.7	20.4	19	19.5	19.965	22.75	23
Base 100 variation of 28 protein index base month (January 2012)	100	197.74	202.07	155.64	153.38	142.86	146.62	150.11	171.05	172.93
Soy Calculation										
Percentage variation from the base month (January 2012)		131.58%	136.84%	63.16%	55.26%	52.63%	52.63%	58.95%	89.47%	97.37%
Percentage variation from the previous month		131.58%	2.27%	-31.11%	-4.84%	-1.69%	0.00%	4.14%	19.21%	4.17%
Corn Calculation										
Percentage variation from the base month (January 2012)		25.00%	20.83%	12.50%	25.00%	21.67%	23.33%	20.83%	18.33%	-4.17%
Percentage variation from the previous month		25.00%	-3.33%	-6.90%	11.11%	-2.67%	1.37%	-2.03%	-2.07%	-19.01%
DORB Calculation										
Percentage variation from the base month (January 2012)		57.14%	71.43%	92.86%	92.86%	31.43%	57.14%	57.14%	71.43%	85.71%
Percentage variation from the previous month		57.14%	9.09%	12.50%	0.00%	-31.85%	19.57%	0.00%	9.09%	8.33%

Source: Uno Feeds, Bhimavaram, Andhra Pradesh

