

Red meat consumption: a threat towards cardiovascular diseases

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ABSTRACT

Cardiovascular diseases are a major killer and the occurrence of cardiovascular diseases (CVD) is related to diet which we consume. Major risk factors associated with cardiovascular diseases are physical inactivity, smoking, dietary patterns etc. The consumption of meat is also associated with cardiovascular diseases mostly due to the use of processed red meat. Mechanism involved in red meat consumption and occurrence of CVD involved the gut microbes. The major component present in red meat named L-carnitine. Gut microbes convert this compound into toxic compound into trimethyl Amine (TMO), which is further converted into another toxic compound trimethylamine-N-oxide (TMAO), which cause the atherosclerosis and leads toward heart failure and other CVD. Red meat also contain toxic N-nitroso compounds which are a major risk factors in promoting hyper tension, which in fact a major cause of CVD. Consumption of red meat is a threat towards cardiovascular diseases mostly processed red meat product. Diet is a major factor which can control the occurrence and prevention of heart diseases.

Introduction

A major cause in occurrence of cardiovascular diseases is Diet. Cholesterol present in diet and also the fat contributes in production of CVD's. Meat is directly related with the CVD's due to the reason because it have cholesterol and fat as a major component of its composition. Therefore American health association recommends fruit and vegetables rather than meat as a diet. (Krauss *et al.*, 2000). Red meat is therefore known as a threat towards heart health because it contains a large amount of cholesterol and dietary fat; however red meat also contains some components which improve cardiac health like omega-3 fatty acids. According to different researches saturated fatty acids present in red meat increase the amount of low density cholesterol which cause the blockage of arteries called atherosclerosis that promote the CVD's (Tarino *et al.*, 2010). In comparison of processed and unprocessed red meat, they differ in their nutritional composition, they differ in their energy, compositional components such as iron, salt and preservatives such as nitrites which are used to increase the shelf life of these processed meat products, they may have a difference according to the method by which they prepared for example cooking at high temperature and cooking at high pressure will both effect differently towards the cardiac health. By concluding many studies processed red meat products

have a great risk towards heart health and it is related with the promotion of CVD's if use in large quantities (Bernstein *et al.*, 2010).

Cardiovascular diseases

All the conditions and malfunctions which are related to heart, blood flow and blood vessels referred as cardiovascular diseases. The main types of CVD are coronary heart disease, stroke and heart failure/cardiomyopathy. (Australian Institute of Health and Welfare. 2011). CVDs include diseases of the heart, vascular diseases of the brain and diseases of blood vessels. CVDs are responsible for over 17.3 million deaths per year and are the leading causes of death in the world (Wikipedia, 2011).

Types of cardiovascular diseases:

Cardiovascular diseases are of many different types, these are may be due to blockage of arteries with cholesterol known as atherosclerosis, ischemic disease of heart or coronary artery disease (failure of heart), cerebrovascular disease (e.g. stroke), diseases of the aorta and arteries, including hypertension and peripheral vascular disease. Other CVDs are congenital heart disease, rheumatic heart disease, cardiomyopathies and cardiac arrhythmias. (Global Atlas on cardiovascular disease prevention and control. 2011).

Atherosclerotic disease

Major reason behind the cardiovascular diseases (CVD's) is hypertension, myocardial infarction (MI), heart attack, stroke, claudication and atherosclerosis. It is mostly occur at place where vessels start dividing, mostly in middle sized and large sized arteries. Mostly this is affected with the type of blood flow, places which are open to the normal shear and pressure looks like be confined; here endothelial cells express atheroprotective genes (Gimbrone *et al.*, 2000). However adventitia may cause in development of atherosclerosis, and is characterized by lymphocyte infiltrates (Campbell *et al.*, 2012).

Rheumatic heart disease

In many countries mainly in most of the developing countries the most widespread acquired disease in offspring is rheumatic heart disease (Mendis *et al.*, 2011). Worldwide the rheumatic fever mainly of children is mostly in the areas which are not fully developed, and where the people are suffering with poverty. This is a chronic heart condition followed by rheumatic fever and it can be prohibited and controlled. Major cause of this fever is strep infection due to streptococcal which in turn causes rheumatic heart disease. If this strep throat infection treated with antibiotics this can prevent this fever and control rheumatic fever. However antibiotics taken on regular bases that is on monthly bases can also prevent this disease from contracting further strep infections and causing progression of valve damage. (Puska *et al.*, 2011). RHD is an inflammatory disease that can cause damage to the heart muscle, valves and lining; connective tissues can also affected by this in the brain and skeletal system (Penm, 2008). RHD is most commonly occur due to bacterial throat infection if it remain untreated, mainly due to streptococcus (Carapetis *et al.*, 1998; Parnaby *et al.*, 2010; Stewart *et al.*, 2007; Kerdemelidis *et al.*, 2010). Recently, more, strep infection may be a reason of skin sores. (Carapetis *et al.*, 1998; Parnaby *et al.*, 2010; Stewart *et al.*, 2007; Kerdemelidis *et al.*, 2010; Couzos *et al.*, 2003)

Congenital heart disease

Defects in heart structure and function since birth are known as congenital defects of heart. The reason behind this is the relation between mother and children immune system and blood system (consanguinity); due to disease of mother which transfer to the offspring's or due to use of drugs and alcohol by mother or due to deficiency of essential nutrients (e.g. deficiency of folic acid). But some the reasons that

why these congenial heart diseases occur are not known. Heart having a central hole and abnormal structure of arteries and also of 4 compartments are due to congenital heart diseases. CVD's also includes disease of heart muscles (e.g. cardiomyopathy), disorders in the pumping system of heart (e.g. cardiac arrhythmias) and heart valve diseases but there occurrence is much lesser than the heart failure and stroke (GACVDPC, 2011). Congenital cardiovascular defects, also known as congenital heart defects, are due to malformation of heart and major arteries also known as structural problems of heart. The common complex defects include the following: Tetralogy of Fallot (TOF), Transposition of the great arteries, Atrioventricular septal defects (ASD), Coarctation of the aorta, Hypo plastic left heart syndrome (Mozaffarian *et al.*, 2015).

Risk factors or promoters of cardiovascular diseases

No physical activity and increased blood glucose level are major factors. Other than these there are some major risk factors involved in the production of CVD's could not be controlled. In terms of attributable deaths, in which at first is high level of glucose in blood which contributed 13 percent deaths worldwide, then at 2nd is use of tobacco which contributed 9 percent, raised blood glucose (6 per cent), physical inactivity (6 per cent) and overweight and obesity (5 per cent). (GACVDPC, 2011).

Hypertension

More than one billion people of the world have the problem of hypertension and half of them are from the countries which are not fully developed (World Health Organization., 2012). One major cause of premature death is hypertension and this is increasing day by day; in 2025, it is estimated that 1.56 billion adults will be living with hypertension. (World Health Organization, 2012). Major cause of CVD worldwide is mainly hypertension. (GACVDPC. 2011)

Unhealthy diet

If diet is rich in fat especially in saturated fats and trans fats and contain less fruits and fish then there is a great risk of production of CVD's. (Global Atlas on Cardiovascular Disease Prevention and Control, 2011). Salt is also an important factor which cause hypertension which is directly related with cardiovascular disease occurrence and the WHO recommends a population salt intake of less than 5 grams/person/n increased amount day to help the prevention of CVD (Global Atlas on Cardiovascular Disease Prevention and Control, 2011). More

consumption of red and processed meat is related to all these factors because red meat is rich in fats including saturated fat and trans fats which cause obesity in turn which results in hypertension which cause CVD's. (Global Atlas on Cardiovascular Disease Prevention and Control, 2011). These should be eliminated from the diet and should be replaced with the fruit and vegetables to prevent the cardiovascular diseases.

Other factors

Use of Tobacco ,increased level of sugar in blood (diabetes) ,Physical inactivity, Cholesterol/lipids, Overweight and obesity , age , Gender ,and family history are some other factors which are associated with promotion or increased risk of cardiovascular diseases.(WHO, 2012).

Red meat

The link in red meat intake and risk of cardiovascular diseases is obvious and is a danger to health. By comparing vegetarian's with non-vegetarian's it was founded that there are increase chances of cardiovascular diseases occurrence in people who consume more meat then vegetables. If consumption of meat is more than three times in a week then there will be two fold increases in risk of cardiovascular diseases occurrence. (Snowdon *et al.*, 1984). In the Nurse.s Health Study, there is a great production of cardiovascular disease who consume more meat than the fish and vegetables (Stampfer *et al.*, 1999). In another study, greater consumption of heme-iron, which is mainly derived from red meat, was associated with a higher risk of fatal and non-fatal CHD events (Ascherio *et al.*, 1994). Another method associated with the intake of red meat and increasing the production of cardiovascular diseases is that red meat increase the amount of total cholesterol present in body. This total cholesterol cause the cardiovascular diseases. Total cholesterol is composed of three main elements: Low -density lipoprotein cholesterol (.LDL cholesterol.), High-density lipoprotein cholesterol (.HDL cholesterol.) and triglycerides. In all of them triglycerides is the major risk factor towards cardiovascular diseases (Connor *et al.*, 1997). LDL cholesterol is known as ba cholesterol however HDL cholesterol is known as good cholesterol because it is protective aginst the cardiovascular diseases. Red meat is a threat towards cardiovascular diseases because it contains a large amount of saturated and trans fats. These saturated fats change the good cholesterol (Bonanome *et al.*, 1988). In general risk of cardiovascular diseases occurrence depends upon ratio of saturated fats which increase the cholesterol level and unsaturated fat which lower the cholesterol level.

Other than these cholesterol increasing fat there are also some other components of meat which are associated with increased risk of cardiovascular diseases such as animal proteins and some other amino acids (Thomas *et al.*, 2003).

What makes these meat products dangerous

Red and processed red meat products contain a large amount of DNA-destroying components named as N-nitroso compounds. Animal products have an iron component named as heme, it increases the formation of N-nitroso compounds. Cross *et al.*, 2003). These compounds are present in red processed meat products because they are preserved with nitrites. These compounds (N-nitroso) are risk factors for cancer promotion. (Loh *et al.*, 2011). These processed meat products also contains a high level of sodium, used as preservative. These is a direct relation between sodium and hypertension which is cause due to high blood pressure. (Johnson *et al.*, 2001; Macgregor *et al.*, 2002). 80 percent of salt from dietary sources comes from these processed meat products, (Appel *et al.*, 2006). This salt intake cause an increase in high blood pressure which is directly related to cardiovascular diseases occurrence like heart failure, stroke, heart attack and atherosclerosis (Appel *et al.*, 2006). Red meat and its products are also a source of saturated fatty acids which increase the occurrence of cardiovascular disease, obesity, (Phillips *et al.*, 2012) and diabetes (Petersen *et al.*, 2004).

Red meat relation with cardiovascular diseases

A group of diseases known as major killer is cardiovascular diseases. Almost more than half deaths occur due to CVD's and most of them are in developing countries, (Centers for Disease Control and Prevention (CDC, 2013) and major control that can prevent these diseases is diet control. Both unprocessed red meat and processed red meat contain large amount of sodium and cholesterol that increase the risk of cardiovascular diseases. (Danlel *et al.*, 2011). Studies found a strong relation in between consuming processed meat products and risk of deaths from CVD. Those consuming more than 160grams per day of processed meat products had a 30 percent increased risk of death from CVD, compared with those who consumed 10 to 20 grams per day.10Results from the Health Professionals Follow-up Study (HPFS) and the Nurses' Health Study (NHS) indicate that eating just one serving of a processed or think stock unprocessed red meat product a day increases risk of death from diseases such as cancer and heart disease. These studies tracked the diets of 37,698 men from the HPFS and 83,644 women from the NHS for

up to 28 years. All participants were free of CVD and cancer at the start of the study. Risk of death increased by 20 percent for those consuming processed meat products, and for those who had one serving of a red meat product a day, the mortality rate increased by 13 percent (Pan *et al.*, 2011)

What makes the red meat a threat?

A recent research in (2013) suggests that in red meat and also in some nutritional supplements there is a nutrient named as L-carnitine, promotes atherosclerosis when it is provided to enteric bacteria of intestine, it convert into a toxic compound called trimethylamine (TMA), that is then again converted to another toxic compound named as trimethylamine-N-oxide (TMAO) (Koeth *et al.*, 2013). Researchers also found that these bacteria of gut convert choline and phosphatidylcholine which is present in diet, to yield TMA which increase the chances of cardiovascular diseases (Wang *et al.*, 2011; Tang *et al.*, 2013).

There are conflicting results regarding L-carnitine of red meat origin and risk of cardiovascular (CVD) diseases. Trimethyl-amine (TMA) is generated from dietary L-carnitine (TMA), choline and phosphatidylcholine by gut microbiota which is further churn down into a pro-atherogenic substance, tri-methylamine-N-oxide (TMAO) is reported to accelerate atherosclerosis in mice. Longer L-carnitine supplementation in mice resulted in altered cecal microbiota with high level of TMA, TMAO and atherosclerosis. The effects were found vanished when intestinal microbiota growth is suppressed with the use of antibiotics. This indicates that gut microbiota have definite role in generation of proatherogenic substances from red meat (Koeth *et al.*, 2013).

Omnivorous human is therefore, at risk for TMAO production as compared to vegans or vegetarians and high level of TMAO is related to particular bacterial taxa in the human intestine. Not only L-carnitine but also phosphatidylcholine give rise to TMAO production via gut microbiota and therefore, serves as possible risk of CVD adverse events (Joseph, 2013). Phosphatidylcholine of food stuff through microbial metabolism in the gut generate choline and then subsequently to TMAO production which then contribute to cardiovascular events in humans subjects (Tang *et al.*, 2013). There is an amino acid which involves in the production of energy named as L-carnitine, animal products contains large amount of this amino acid, especially red meat; plant food contains no carnitine, and humane body produce this amino acid from other sources that come from Diet,

for example methionine and lysine. Studying mice, the scientists found that gut bacteria of humane intestine metabolized this amino acid carnitine, which produce a substance trimethylamine-N-oxide (TMAO) which involves in the development of atherosclerosis, by decreasing the release of cholesterol from the arterial wall.

Several researchers confirm findings by applying them on human. By testing, the level of amino acid named as carnitine and TMAO in the human, they concluded that increased level of both compounds is directly related with the occurrence of cardiovascular diseases (heart failure and stroke). By utilizing the carnitine supplements the production level of TMAO increased in omnivores than in vegetarians. Moreover the kind of intestinal bacteria in humans which consume red meat were different from those which were found in people who consume vegetables and vegans. These results suggest that eating red meat and other foods that consist of amino acid named as carnitine increase the number of intestinal microbiota which convert carnitine into a substance TMAO that increase the heart diseases (Koeth *et al.*, 2013) (Wang *et al.*, 2011), (Woolston *et al.*, 2013). Eating red meat provides L-carnitine to intestinal bacteria of humane intestine. Microbiota of humane intestine metabolize L-carnitine and convert it into trimethylamine-N-oxide (TMAO) which is a toxic compound.

CONCLUSION

Red meat is a threat towards cardiovascular diseases. When red meat is consumed its beneficial compound converts into toxic compounds under the action of gut microbes, which cause atherosclerosis, which result in many other (CVD's) like heart failure. L-carnitine, a compound present in red meat when consumed by humans or omnivores it converts into a toxic compound TMAO which is a major risk factor towards cardiovascular diseases. Processed red meat products are more related to promotion of cardiovascular diseases.

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