



Review Article

SESAMUM INDICUM BEFORE AND DURING PREGNANCY: A REVIEW

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(Received: June 27, 2015; Accepted: July 28, 2015)

ABSTRACT

Nutrition is the science or practice of consuming and utilizing food for healthy living. Appropriate nutrition means getting the right amount of nutrients from food in the precise quantity and combinations. Balanced diet is essential for normal growth and development of baby. Proper diet includes supplements like micronutrients, macronutrients, vitamins, minerals, antioxidants, lactating agents etc. After extensive research and evaluation of literature, scientist reached at a point that fat is necessary for development of growing foetus and sesame seeds are highly ranked as one of the nutritional supplement for high fat diet. So the present review article is focused on the importance of sesame seeds as high fat diet because it contains omega-3, omega-6 and DHA which are the important factors for development of brain, eye and many other organs. It also possesses pharmaceutical and nutraceutical applications which are supportive during pregnancy. Many studies are performed on the nutritional values of sesame seeds but the exact role of this herb during pre and postnatal development is not thoroughly studied so in the present review we mainly focused on the role of sesame seeds before and during pregnancy.

Keywords: Sesame seeds, pregnancy, foetus, nutrition, placenta, Body mass index.

INTRODUCTION

A balance diet is required for maintaining optimal health throughout life. For women proper nutrition is necessary for preparing the body for the demands of pregnancy. Proteins, carbohydrates, fats, vitamins, minerals, antioxidants and lactating agents are essential nutrients which are necessary for a pregnant women to reduce adverse birth out comes. Foetal growth and development are basically dependent on the hormonal, nutritional and metabolic environment which is provided by the mother 1.

Body cells need two general classified nutrients i.e. macronutrients and micronutrients. It is postulated that micronutrients include vitamins and minerals which play critical role in foetal health and development 2, 3. Macronutrients include protein, fat and carbohydrate, all of these are necessary during pregnancy and lactation because

these provide the optimum energy required for foetal growth and for the maintenance of expecting mother's health.

Fats are the building blocks for the brain and nervous system. It provides metabolic energy for all the life processes. If we modify the fat components than normal functioning of body get disturbed. Such as a low arachidonic acid in pregnancy reduces birth weight, increases cardiac muscle, insulin resistance, heart rate etc. 4 According to Stamler et al. 5 fat plays an important role in maintaining high blood pressure. Omega-3 and omega-6 polyunsaturated fatty acids (PUFA) are required for normal growth and development of numerous organ systems, most important are the brain and eyes 6. Omega-3 fatty acids is important in the prevention and modulation of certain diseases those are coronary heart disease and stroke, essential fatty acid deficiency in infancy

(retinal and brain development), autoimmune disorders (eg, lupus and nephropathy), crohn disease, cancer (breast, colon, and prostate), mild hypertension and rheumatoid arthritis 7. Fatty acids are important for maternal and infant health 8. The pregnant women are eating for two and during this period rate of metabolic activity increased so extra energy is needed. According to the institute of medicine 9 pregnant women need approximate 300kcal/day in the second and third trimesters. Fat is the intense source of energy and may be beneficial to women who were at risk of energy malnutrition during pregnancy. It is postulated that essential fatty acids play important role in pregnancy 10, 11. Lack of essential fatty acids bring poor vascular growth and consequent coagulation in blood vessels leading to infarctions in the placenta that result in impairment of placental functions and low birth weights 12, 13. Sources of fat diets and requirement of macronutrients during different physiological periods are shown in fig 1 and fig 2.



Fig.1. Different sources of Fat diet

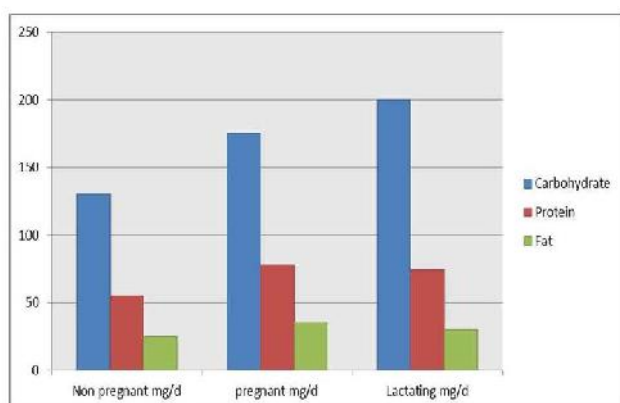


Fig. 2. Macronutrients requirements during different physiological periods

All these are the sources of high fat diet out of which we have selected *Sesamum indicum* for the study because it is inexpensive and generally available in our kitchen.

Negative Impacts of high fat

It is also noticed that a certain level of fatty acids are important for development of body but excess amount of fatty acid may be harmful. High levels of saturated fat and cholesterol contribute to increase in blood pressure by the development of plaques on vessel walls, which results in the reduction of both their elasticity and diameter 14. High fat diet may lead to the development of atherosclerosis which results in the further risk of cardiovascular disease 15, 16.

Chemical composition of Sesame seeds

Scientific classification:

Kingdom: Plantae

Class: Magnoliopsida

Order: Lamiales

Family: Pedaliaceae

Genus: *Sesamum*

Species: *S. indicum*

Sesame seeds belong to family pedaliaceae and it is one of the most popular oil seeds crop. India, Sudan, Burma and China are the chief producer of sesame seeds 17, 18. It plays critical role in human nutrition. Sesame seeds are used for oil extraction and rest of the part used for edible purpose 18, 19. Sesame oil acquires second rank after olive oil as a nutritional value 20. Nutritional value, minerals, amino acids and lipids possess in sesame seeds are summarised in table 1, 2, 3 and 4.

Importance of sesame seeds during pregnancy

The sesame seeds are high energy yielding food and contain many health promoting nutrients, minerals, antioxidants and vitamins, these are essential for human health 21. They are good sources of vitamin-B like niacin, thiamine, folic acid, pyridoxine and riboflavin. It contains important minerals like potassium, phosphorus, magnesium, calcium, iron, manganese, zinc, selenium, copper and sodium 22, 23. All these minerals pass to foetus through placenta 24-29. Zinc maintains normal plasma zinc concentration during gestation which is responsible for normal pregnancy 30. According to Hurley and Swenerton 31 female rats fed with zinc deficient diet throughout pregnancy had fewer offspring with stunted growth and several abnormalities.

Table 1: Nutrients content in sesame seeds (100gm)

Energy	2930kJ (565kcal)
Water	5.2g
Protein	17.7g
Lipids	50.4g
Carbohydrate	10.2g
Fiber	11.2g
Minerals	5.3g

Table 2: List of minerals present in sesame seeds

Sodium	45mg
Potassium	460mg
Magnesium	354mg
Calcium	785mg
Iron	10mg

Table 3: List of amino acids present in sesame seeds

Amino acid	Amount
Arg	2200mg
His	490mg
Ile	930mg
Leu	1540mg
Lys	640mg
Met	640mg
Phe	11250mg
Thr	910mg
Trp	290mg
Tyr	720mg
Val	1110mg

Table 4: List of lipids present in sesame seeds

Lipid	Amount
Palmitic acid	5700mg
Stearic acid	1600mg
Oleic acid	19.9g
Linolic acid	18.7g
Linoleic acid	670mg
Salicylic acid	230ug

Thiamine also passes through placenta and it is necessary for normal foetal growth, excess amount of thiamine increase the rate of cancer in western, Asian and African countries 32. Riboflavin is essential nutrient for foetus, deficiency of riboflavin cause congenital malformations in the developing animal 33. Riboflavin actively transferred across the human placenta 34. Most of these minerals play vital role in bone mineralization, enzyme synthesis, red blood cell production, hormone production and regulation of cardiac and skeletal muscles activities. Fig 3 shows the requirement of micronutrients during different developmental stages.

Sesame seeds also contain essential fatty acids like omega-3 and omega-6 which are also necessary during pregnancy. Omega-3 and omega-6 are essential fatty acids and are not synthesized by the body itself so pregnant women need it in her diet. The paternal omega-6 fatty acid is linoleic acid (LA) and the paternal omega-3 fatty acid is alpha- linolenic acid (ALA) 35, 36. Sources of omega-6 fatty acids are vegetable oils like sunflower oil, sesame oil, corn oil, safflower oil etc. Maternal diet and nutritional supplements are necessary during pregnancy because the foetus completely depends on their mother. It is well known that DHA is necessary for brain development of unborn baby. Foetus takes DHA from maternal lipid stores. During pregnancy, placenta transport AA and DHA from mother to the foetus 37.

Miscellaneous uses of sesame seeds

Sesame oil is used in cooking, certain industrial applications, hair oil and medical purpose 38, 39, 40. Sesame seeds comprises two exclusive substance first one is sesamin and second one is sesamol 41. Overall functional activities of sesamin and sesamol are shown in fig 4. Sesame oil possesses industrial, nutraceutical and pharmaceutical applications. All these applications are summarised in table 5, 6 and 7.

Free radicals can be either harmful or helpful to the body. Balance between formation and removal of free radicals occur in a normal cell. If an imbalance between the formation and removal of free radical occurs, this condition is called as an oxidative stress. If this balance shifted towards more formation of free radicals then levels of antioxidants are diminished 56. Sesame oil neutralizes the flood of oxygen radicals and used for treatment of damage caused by free

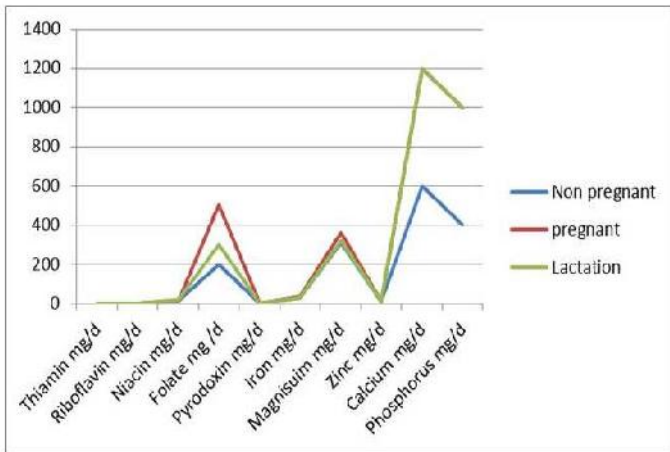


Fig. 3. Micronutrient requirement during different Physiological stages

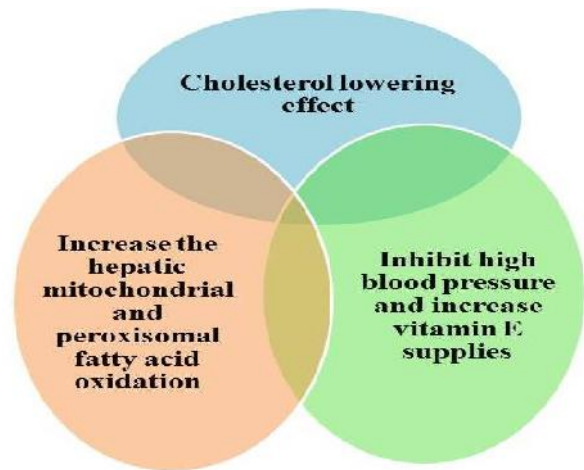


Fig.4. Function of sesamin and sesomolin



Fig.5. Effects of High BMI



Fig.6. Effects of High BMI during pregnancy

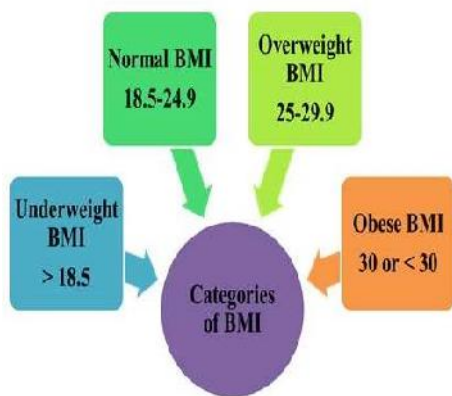


Fig. 7. Different categories of BMI



Fig. 8. Effects of low BMI

Table 5: Industrial uses of sesame seeds

Industrial uses		
S. No.	Uses	composition
1.	Antifungal ^{42, 43}	Sesamin and sesamol
2.	Bactericidal ^{44, 45}	Sesamin and sesamol
3.	Insecticidal ^{44, 46}	Sesamin and sesamol
4.	Cosmetic ⁴⁴	Myristic acid

Table 6: Nutraceutical uses of sesame seeds

Nutraceutical uses		
S. No.	Uses	composition
1.	Antioxidants ^{41, 44, 47, 48}	Lecithin, lignans, sesamin
2.	Cardioprotective ⁴⁹⁻⁵²	Fibre and sesamol oil
3.	Antihypertensive ⁵⁰⁻⁵²	Sesamin
4.	Anti-inflammatory ⁴⁸	Sesamin
5.	Dermatitis ⁴⁹	Lecithin
6.	Reducing hepatic steatosis ⁴⁴	Lecithin
7.	Enhance hepatic fatty acid oxidation ⁵³	Sesamin and sesamol
8.	Skin softener ⁴⁴	Sesame oil
9.	Hemostatic activity ⁴⁹	Cephalin

Table 7: Pharmaceutical uses of sesame seeds

Pharmaceutical uses		
S. No.	Uses	composition
1.	Cancer preventive ⁴⁴	Myristic acid
2.	Hypoglycaemic ⁴⁴	flavonoids
3.	Nasal mucosa dryness, blurred vision, anxiety ⁵⁴	Sesame oil
4.	Laxative and promote mensuration ⁵⁵	Sesame oil

radicals⁴⁵. It protects against air borne viruses and bacteria^{46, 54}. It is also effective in preventing an increase level of serum triacylglycerol and ethanol consumption in rats⁵⁷. Sesame lignans have anti-oxidative and health promoting properties⁵⁸. Feeding it to rats balanced the Fe²⁺ induced oxidative stress. Sesame oil and groundnut oil fed rats had lower levels of hepatic thiobarbituric acid reactive substances, serum glutamate pyruvate transaminase and serum glutamate oxaloacetate transaminase activities. The level of these enzymes indicates protection against Fe²⁺ induced oxidative stress^{59, 60}.

BMI

Body mass index correlates a person's height and weight. BMI is measured by dividing a person's weight in kilograms by the square of person's height in meters and multiplying by 100. The term BMI is widely used for body fat and correlates with other measure of adiposity^{61, 62}. Obesity results in the increased incidence of complication at later gestational stages affecting both mother and foetus. The major issues are the gestational diabetes, pregnancy induced hypertension, stillbirth, pre-eclampsia and thromboembolism⁶³⁻⁶⁶. Fig 5 and 6 shows effects of high BMI during middle age and pregnancy. It is useful tool for diagnosis of malnutrition and obesity, such diagnosis helps in person's age and fitness of gender. It is also related with mortality, lower values generally correlating with longer life⁶⁷.

$$BMI = \frac{Weight (kg)}{(Height\ m \times Height\ m)} \times 100$$

BMI and Fat

High amount of fat in body is defined as obesity⁶⁸ and BMI is used to describe obesity. Fatty diet causes obesity, which is the key factor of most complex and chronic diseases. It is related with many chronic disorders such as Non-Alcoholic Fatty Liver Disease (NAFLD)⁶⁹. A recent study observed that diet high in MUFA in obese males resulted in weight loss as compared with a diet rich in saturated fatty acids⁷⁰. Different categories of BMI and effects of low BMI are shown in fig 7 and 8.

BMI and Sesame seeds

Sesame seeds are included in healthy foods due to the high levels of mono- and poly-unsaturated fatty acids, vitamin E, fibre, phytosterols and some nutraceutical components like

bioactive lignans, sesamin, sesamol, episesamin, and sesamolins^{19, 71}. Willet⁷² observed that increase body weight is directly related with high percentage of fat in the diet. After reviewing many studies based on consumption of sesame seeds with various combinations, some scientist suggested that after eating sesame seeds in diet with or without vitamin C increases body weight in experimental animals⁷³⁻⁷⁸.

But According to Alipoor et al.⁷⁹ no significant changes were observed in anthropometric indexes like weight and BMI after eating sesame seeds. It is suggested that significant weight gain was noticed in the treated groups, which were fed with high amount of sesame seeds. It was observed that weight gain in different experimental groups were dependent upon the quantity of the food consumed loaded with sesame diet⁸⁰.

It is also concluded by Sankar et al.^{81, 82} that supplementation of sesame seeds resulted in weight loss and reductions in body mass index (BMI). It is observed that the body weight gain during the treatment period did not differ significantly among groups. No behavioural and clinical changes were observed in the animals treated with the sesame seed⁸³. According to the general hypothesis, high fat diet increases the body weight, but in the study conducted by Jain et al.⁸⁴ in Swiss mice on the role of macronutrient during pregnancy and lactation, they observed that the body weight of pups were reduced when their mothers are fed with high fat diet during pregnancy and lactation.

CONCLUSION

The different studies of the researchers reveal that sesame seeds possess essential nutrients, minerals, fatty acids etc. which are beneficial during pregnancy and lactation without any side effects at a certain level. Fatty diets are concentrated source of energy. Sesame seeds are also rich in omega-3, omega-6 and DHA which are important for the nourishment of the pregnant and lactating women who are at greater risk of energy malnutrition. It also possesses pharmaceutical, nutraceuticals and therapeutic properties, which contribute to safe pregnancy and boost postnatal growth. The reports discussed in the present review are not sufficient to conclude any concrete conclusion in this direction.

More detailed studies are needed to fulfil this lacuna in our understanding related to this problem.

Acknowledgement

We are obliged to our department for providing all the basic necessary facilities required in this work. One of us (Neelam Jain) is thankful to DST, New Delhi for providing the financial support.

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