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A REVIEW ON ROLE OF NUTRACEUTICALS IN AUGMENTING REPRODUCTIVE HEALTH AND FERTILITY

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ABSTRACT: Reproductive health and fertility can be shaped by a delicate balance of hormones, body functions, environment influences and lifestyle modifications. In recent years there's been growing interest in role of nutraceuticals as these nutraceuticals consists of important vitamins, minerals, and antioxidants, nutritional foods that are crucial for improving reproductive health. Avocados, nuts, seeds, whole grains, green vegetables, fruits, and legumes are nutrient-rich foods that are known to promote hormonal balance, enhance the quality of eggs and sperm, and inhibit oxidative stress in reproductive organs. Particularly critical nutrients for enhancing ovulation, endometrial health, and sperm motility are folate, zinc, Tocopherols, iron, and omega-3 fatty acids. Additionally, diets high in antioxidants protects gametes from damage caused by free radicals, augmenting the probability of conception. A balanced lifestyle and adequate consumption of these fertility-promoting foods can help control infertility and greatly enhance reproductive results. Nutritious diets are therefore a safe, all-natural, and successful therapeutic strategy for treating infertility.

INTRODUCTION: Infertility is the inability to attain a pregnancy after more than one year of unprotected sexual intercourse. Infertility also serves as a marker for a basal chronic disorder. Luteinizing hormone and follicle stimulating hormone and drugs that inhibit enzyme aromatase like letrozole, help to stimulate ovulation throughout the cycles of IVF. In a recent span of 20 years some predominant changes occurred in the practice of infertility which include development in assisted technologies of reproduction which given a chance for studying the process occur in reproduction and also changes occurred in the society like an improvement in number of women who are dreaming to get pregnant at age of 35^{1, 46, 47}.

In recent years infertility effects 15% of all fertile couples, raising concern across the world. Female infertility comprises about 35% of all infertility issues. While male infertility contributes 30% of infertility cases, but 15% cases related to infertility are inexplicable. Globally, an evaluated 70 million couples experiencing the infertility, but in accordance with WHO guidelines, approximately 80 million females experiencing infertility on worldwide. In united states, a population of 3.3-4.7 million men seeking medical help for fertility issues (or) infertility^{1, 2}.

Etiology:

In Males:

- 1. Ejaculatory Disorders:** Include anejaculation and retrograde ejaculation³.
- 2. Pubertal Growth:** Obstruction in ejaculatory duct, veins dilation in testis. Spermatic cord of testis, this condition is known as varicocele⁴.
- 3. Smoking:** Decreases in the quality of men who Spermatozoa in both healthy men and men



suffering a fertility problems (this data was concluded by systematic review that included males from a total of 26 different countries) ⁴.

4. **Alcohol:** Detrimental effects of alcohol on structure and mobility of sperms was observed and extent of these effects depends on dose ⁴.

In Females:

1. **Ovulatory Disorders:** 25 percent of the familiar reasons of infertility in females are due to ovulatory dysfunction. Those ovulatory disorders include polycystic ovarian syndrome Normogonadotropic normoestrogenic anovulation, Pituitary adenoma Hyperprolactinemic anovulation and hypothalamic amenorrhea ⁵.
2. **Endometriosis:** It is defined as a pathological condition where there is a development of endometrium-like tissue in exterior part of uterus ⁶.
3. **Genetics:** Genetic anomalies that causes condition of infertility in case of females includes chromosomal aberrations at high level, variations in the sequencing of DNA in genes which direct several processes that are involved in oogenesis ⁸.
4. Anatomical factors that lead to infertility in females are structural abnormalities in uterus which may present from birth or may be acquired ⁷.
5. Hyperprolactinemia ⁵
6. Tubal blockage ⁵

Pathogenesis of Infertility:

In Females: Abnormalities in chromosomes like turner's syndrome where there will be loss of one of the paired chromosomes (monosomy), disruption of balance in rearrangements of X-chromosome which will ultimately leads to increased drop in oocytes count during the development of female foetus that results in the formation of non-functional gonads ⁸.

Rare detrimental changes in genes like helicase for meiosis-1, REC 8, nucleoporin 107 KDa, synaptonemal complex protein-3 effects the segregation of the chromosomes during reduction

division leads to disturbance in the meiosis, mutations in genes like STAG-3 and SMC1B associated with infertility ⁸. In printed works it's been observed that there is a correlation of endometriosis leading to infertility but still complete effect of endometriosis on causing infertility need to be determined. In endometriosis due to the liberation of immune mediators like NO and cytokines there is a surge in both activity and quantity of the macrophages. It's been recorded that these enormous amount of nitric oxide causes harmful influence on the functioning of fallopian tubes ultimately reducing the fertility. It is also observed that nitric oxides cause a decline in the ability of attachment of embryos to uterus which is said to be Implantation ⁹.

In Males:

Y-chromosome and Oxidative Stress: DNA in chromosome-Y is susceptible to damage partially due to its genetic organization and anomalous recombination's generally this impairment of Y-chromosome leads to infertility condition ¹⁰.

Oxidative Stress and Accessory Glands Disorders in Males: These disorders linked with changed secretions by accessory glands and appearance of WBC, leads to decrease in oxygen scavenging activity in the secretions of accessory glands, enhanced damage to sperms due to oxidative stress ultimately this causes inhibitory effect on fertility of males ¹⁰.

Caspases are type of enzymes that breakdown proteins at the position of aspartate amino acid. Caspase-3 activated because of the abnormalities in mitochondria and nucleus and was linked to the declined mobility and irregular structure of spermatozoa. In spermatozoa caspase-9 resides primarily in middle piece region. It is observed that there is an increased magnitude of caspase-9 in men suffering with infertility. Zalata concluded that caspases, type-3 and type-9 have detrimental effects on mobility, quantity and speed of spermatozoa ^{11, 12}.

Prostatitis occurs because of the infections caused by bacteria. Bacterial colonization in the prostate gland causing obliteration of native cells of prostate gland and release of inflammatory factors like anti-sperm antibodies and cytokines, this results in

accumulation of wastes generated due to cell injury and inflammatory factors into secretions of prostate, these secretions become constituents of seminal plasma that leads to sperm injury. These cytokines present in fluids of prostate gland led to increased formation of reactive oxygen species; this causes changes in motility of sperms and sperm injury leading to infertility in males ¹³.

Nutritional Management in Infertility:

Fruits:

Mango:

Scientific Name: *Mangifera indica*

Family: Anacardiaceae

It is composed of chemical constituents that may cause positive impact on health of human beings. The main phytoconstituents present in mango are vitamins like vitamin-C, vitamin-E, phenolic acids Flavonoids, carbohydrates, folates and zinc, in which the important flavonoids present in the pulp of mango are Quercetin, it's glycosides like quercetin-3-glucoside ¹⁴.

Quercetin possess antioxidant due to which this phytoconstituent getting focused in regarding the improvement of male fertility studies, but in printed works it is reported that this component has the ability protect cells from free radicals but also has the ability induce oxidative stress, so this indicates quercetin has contradiction activity in abnormalities of reproduction in males, this difference in the functioning of quercetin can be understand by determining the sperms response to the different concentration of quercetin. In recent studies it came to know that quercetin at concentration of 0.1 nanomolar to 1 millimolar activates the mitochondrial respiration. But it is also noticed that quercetin at concentrations equal to or greater than 0.01 mM concentration causes uncoupling in the transport of electrons and phosphorylation ¹⁵.

Molecular Mechanism of Quercetin: Quercetin directly interacts with the coenzyme-Q binding site present in the membrane of mitochondria, this interaction will ultimately suppress production of super oxides and ultimately increase ATP production and fertility in males also get affected due to heavy metals accumulation like cadmium,

arsenic and mercury inside reproductive organs. These metals have ability to cross barrier between blood and testis, cause harmful effects on motility and production of sperms. Results of number of studies showed that quercetin can decrease toxic effects of the heavy metals by forming complex with the reactive oxygen species and Quercetin also increased number of sperms and capacity of proliferation thus help in improving functioning of reproductive system in males ^{15, 16}.

Mango also possesses vitamin C (water soluble) and vitamin E (lipid soluble) which are the main antioxidants and play an important role in controlling free radicals during reproduction in males. Vitamin E includes tocotrienols, tocopherols in which alpha tocopherol is most effective form.

It is said that vitamin E plays a significant role in safeguarding membranes of sperms from the lipid peroxidation, and it also improve functioning of mitochondria and thus protect sperm and mitochondria from oxidative stress and Vitamin C helps in recycling of vitamin E Several research had been done to know the vitamin C effects on the functioning of sperms, and it has come to know that by taking vitamin C the quality of semen is improved ¹⁵.

Mechanism of Vitamin C: As an antioxidant it reduces the stress due to oxidation and change the internal conditions of testis and ultimately increases motility of sperm by elevating energy production in sperm and Vitamin C have two target enzymes present in mitochondria that include ATPase and succinate dehydrogenase ¹⁵.

Folates and Zinc: Along with other nutrients folates play a significant role in production of sperms i.e. spermatogenesis. During a random trial it is found that folate, zinc and combination of these two are introduced into a sub fertile man and it is found that combination of zinc and folate lead to increase in sperm count by 74 percent, but they do not have effect on concentrations of testosterone. It is also found that intake of folate by healthy men leads to decrease in chance of disomy 21 and sex nullisomy. In studies it is found that diets deficient folate in rodents caused a decline in pregnancy rates ¹⁷.

Avocado: Mother's nutrition is essential for fertility, breast milk composition, fetus development and birth outcomes. Mediterranean-style diet has proving in recent research's that thus are enhancing the human fertility rates. This is because this mediterranean-style diet will decrease the risk of hypertension, obesity and ovulatory disorders in infertile women. Avocado is the food style of medication and avocado are rich in fibers and antioxidants; it contains fatty acids MUFA [Mono saturated fatty acid] is the constituents naturally present in Avocado. Scientists identified that intake of just 2% of energy in the unprocessed MUFA than Hydrogenated trans fats which reduce the risk of ovulatory infertility. The unsaturated fatty acid Example: Unprocessed MUFA which is present in fruits and vegetables will binds to the peroxisome proliferator-Activated receptor GAMMA (PPAR GAMMA). It will decrease inflammation and ovulatory function is increased¹⁸.

In a diet SAF [Saturated fatty acid] is more and PUFA/MUFA is low then that diet is unbalanced diet or unbalanced ratio it negatively affects quality of sperm. PUFA/MUFA will improve sperm quality. If saturated fat is present in a person's diet it will inversely correlate in total sperm count and concentration. As that if we add Omega-3 fatty acid is close correlated in total sperm quality.

Not only Omega-3 fatty acid will improve sperm quality some other nutrients are important. To know the fatty acid role in sperm dysfunction. Scientist used subject like Rodents and Rabbits which is induced with obesity. Scientist's Identified that PUFA can involve in reproductive processes, directly or indirectly in various mechanisms. Example: PUFA will reduce fat and cure obesity and stops the development of infertility and also it will act as on aspect which is linked with male infertility. In sperm membrane fatty acid is also one of the important components. Fluidity and dynamics are essential for promoting fertilization or improve fertilization. They are also important for eicosanoids synthesis. They control the enzymes which is helpful in steroids metabolism¹⁵.

Walnuts:

Scientific Name: *Juglans regia*

Chemical Constituents: Omega-6-fatty acids, Omega-3-fatty acids, Alpha-linolenic acid (ALA).

Diet plays a major role in successful human reproduction; less intake of folate can cause sperm chromosomal abnormality and polyunsaturated fatty acids play a vital role in the sperm maturation. By taking the walnuts in the diet, it can improve the sperm motility and also acts as an antioxidant to the sperm. The nutrients which are present in the walnuts can develops the characteristics of the sperm in the epididymis. Walnut consists of omega-6-fatty acids, omega-3-fatty acids, and alpha linolenic acid (ALA). These constituents present in the walnuts can improve the sperm vitality, motility and morphology. So, it is one of the dietary recommendations for infertility people to improve the fertility and daily intake of walnuts can improve (or) develop the reproductive health due to high concentration of omega-3-polyunsaturated fatty acids, vitamins, polyphenols, minerals and dietary fibres present in nut. The nut consumption 75g/daily for at least 3 months in the diet to improve the sperm motility, vitality and morphology but does not show the effect on sperm concentration¹⁹.

The main chemical constituents of nuts are Alpha linolenic acid and monounsaturated fatty acids, vitamin E, polyphenols, selenium, zinc, protein Fibers (or) Dietary fibers, along with folate, Copper and fatty acids like linolenic acid, Palmitic acid, oleic acid, stearic acids. The Alpha linolenic acid (ALA) and Monounsaturated fatty acids (MUFAs) have the higher fatty acid composition in the sperm membrane and also in follicular fluid in females. Mainly the polyphenols and antioxidants can show impact on the oxidative damage and inflammation^{21, 22}.

Mechanism of Action of Nuts: The fatty acid composition in sperm membrane can increases the sperm fluidity and motility and also anti-inflammatory pathway. Vitamin E, polyphenols, selenium, and zinc present in nuts will increases the antioxidant capacity on sperms and sperm production, quality, also prevents the sperm DNA fragmentation in males. In females they cause follicle development that leads to the high-quality oocytes and helps in the embryo development.

The proteins and fibres preset higher amount in nuts that helpful for low gastrointestinal activity and gut bacterial composition change leads to increase the insulin sensitivity (or) glucose levels regulates the ovulation frequency and development of oocytes in females^{20, 21}.

Beneficial Effects of Walnuts on Male Fertility:

Walnuts are also called as *Juglans regia*. In the past few years, scientists concentrated on the how the walnuts can improve the male fertility. The first clinical trial was developed by Robbins *et al.* In this case 117 members are selected irregularly under 21-35 years age for control group as well as walnut nutritional diet group. The walnut nutritional group taking about 75 grams per day for 3 months. The trail concluded that the walnut nutritional group enhances the motility, vitality and morphology of sperms (but does not affect on the sperm concentration) when compared to the control group. Another trail was developed by Materson *et al.* In this case the study conducted on 75 members of infertility males aged 27-61 years. 45 grams of whole shelled walnuts were given daily for 3 months. This test mainly concludes the enhancement of sperm motility and semen parameters²¹.

The daily intake of 45 grams whole shelled walnuts can improve the sperm motility, vitality and morphology and enhance the fertility in males. Poly unsaturated fatty acids (omega-3- fatty acids) and antioxidants are present in walnuts can increase the sperm quality and maintain functioning of sperms²².

Grapes: Reproductive problems can arise from oxidative stress, which triggers inflammation and leads to disorders such as endometriosis, cancer in ovaries, maturation of oocyte and impaired follicle development, and hormone release. Bioactive compounds with antioxidant and anti-inflammatory effects, like polyphenols, may help protect reproductive health. Grape seed extract, for example, has improved fertility in hens. Although studies are limited, current evidence suggests grape polyphenols could support female reproductive functions²³. Grape seeds, rich in natural antioxidants, help protect the body from oxidative stress. Grape-derived products have been shown to protect sperm from oxidative damage *in-vitro* and

enhance sperm quality, thereby improving fertility in males²⁴.

Vegetables:

Tomato:

Scientific name: *Solanum lycopersicum*

Family: Solanaceae

After potato this is the vegetable crop which is of greater importance²⁵.

Chemical constituents: Main compounds that are present in fully mature tomatoes are carotenoids, phenolics and Beta-carotene and it also composed of lycopene that imparts the red color to tomato²⁶.

Lycopene: Tomato is one of the dietary sources that contain lycopene, which belongs to carotenoids and generally a red color imparting pigment. According to a study, the conclusion was that highest concentration of lycopene was found in testes So, lycopene play an important role in formation of sperms as antioxidant.

It was also found that infertile men had low levels of lycopene which increased incidence of production of abnormal sperms due to oxidative damage that ultimately caused infertility So, it is said that consumption of lycopene will decrease oxidative stress and gives safety from reactive oxidative species in a recent randomized control trial, it is found that in a span of 12 weeks there is an increase in the concentration and count in spermatozoa and during other randomized clinical trials showed that consumption of 20mg lycopene, two times in a day , leads to reduction in the stress due to oxidation within seminal plasma A study showed that the couples who consumed lycopene in a three months period showed a extemporaneous conception^{27, 28}.

Mechanism of Action of Lycopene: As an antioxidant lycopene snuff out reactive oxygen species that ultimately causes reduction in reactive oxidative species and decreases oxidation of lipids stabilize cell membrane of sperms and lycopene also increases concentration of antioxidant enzymes indirectly by stimulating antioxidant system²⁷.

Lycopene encourages redox mechanism and snuff out the oxygen ions, as it contains free electrons in its structure. As a powerful antioxidant lycopene counteracts free radicals like hydroxyl and nitro radicals and lycopene also decreases oxidative stress, levels of reactive oxygen species and increases levels of antioxidant in seminal fluid²⁹.

To protect lycopene during the process of digestion it is given in combination alongside whey protein, this combination is known as lactolycopene. Its effect was studied by Williams *et al* showed that consumption of lactolycopene for 3 months leads to better motility, morphology of sperms in hales and heartly individuals during a research flavonoids and polyphenols present in tomato showed that these constituents may play a significant role in improving the quality of semen, structural integrity and vitality of spermatozoa³⁰.

Incubation of sperms together with lycopene reduced the damage to mitochondria of sperm due to oxidation and lycopene also prevents spermatozoa mortality thus improving Anti-apoptosis capacity of sperms³¹.

Spinach: Spinach composed of hydroxy cinnamates like ferulic acid and caffeic acid³².

Ferulic Acid: In its structure ferulic acid contain phenolic hydroxy group which gives the antioxidant ability to ferulic acid. Latest findings shows that the phenolic hydroxy groups of ferulic acid directly attack the free radicals³³.

Mechanism of Action: It activates cGMP led to improvement in metabolism and motility of sperms in echinoderms like sea urchin So ferulic acid may influence motility of sperms in mammals like us and ferulic acid also caused an improvement in the total antioxidant capacity levels, useful to maintain viability of sperms of humans, not only in infertile but also in fertile humans, this protective effect of ferulic acid on semen will depend on dose^{33, 34}.

During storage of semen with ferulic acid it is observed that there is an improvement in the motility of sperm, integrity of acrosome and cell membrane of sperms and decline in levels of malondialdehyde and reactive oxygen species³⁴. Administration of ferulic acid lead to improvement in oocyte maturation rate and the quality of oocyte

after *in-vitro* maturation and capacity of development of IVF formed embryos and ferulic acid decreases levels of oxidative stress in the oocytes of bovine, also improves m-RNA expression levels of genes that are associated with pluripotency of embryo maturation of oocytes and cumulus cell expansion. In oocyte ferulic acid also improves the velocity of extrusion of first polar body³⁵.

Beet Root: Scientific name for beetroot is *Beta vulgaris*, this beetroot [*Beta vulgaris*] and is grouped within the Chenopodiaceae family. In traditional time Romans using this beetroot [*Beta vulgaris*] for treatment for Pyrexia and Constipation. Hippocrates used *Beta vulgaris* for wound healing. Beetroot juice is used to improve human fertility in middle aged people and mainly composed of micronutrients such as Boron metal is very beneficial supplements in increasing sexual hormones. Boron and male sex hormones [Testosterone] both have strong relation. Sex hormone concentration is also increased, and quality of sperm is also improved. Beetroot also rich in nitrates which is absorbed in proximal intestine due to this production of nitric acid also increased. This is also one of the reasons that leads to increased fertility observed in beetroot and beetroot plays an important role in the development of foetus. It is also used to treat some other diseases such as heart diseases, lung diseases, and liver diseases³⁶.

Beans and Lentils:
Soyabean:

Scientific Name: Glycine Max

Soyabean possess chemical (non-isoflavone) constituents that includes Phytic acid, Sterols, Triterpenes, Unsaturated fatty acids, Bowman birk protease inhibitors, Saponins & Inositol phosphate. These constituents have antioxidant property. Soy food and soy components shows that the beneficial effects on women with fertility issues and during Assisted reproductive technologies (ART) and soy consumption is helpful for control the menopause symptoms in women³⁷. Based on the chemical structure phytoestrogens are classified into several molecules which includes: Stilbens (Resveratrol), Lignans (Matairesinol), Isoflavones (biochanin A,

daidzein and genistein) coumestans (4-methoxy coumestrol and coumestrol). Isoflavones are non-steroidal substances (or) oestrogens which are structurally related to the endogenous oestrogens these are also known as phytoestrogens and isoflavones act as tissue selective oestrogen complex. There are two isoforms of oestrogen receptors i.e. α and β receptors have different expressions in body tissues. The isoflavones act as selective tissue oestrogen activity regulators shows the both the both stimulatory and inhibitory activity on oestrogen receptors^{37, 38}.

Mechanism of action of Isoflavones: Oestrogen which are produced endogenously and isoflavones are structurally similar to each other. The interactions between these two classes of compounds show a competitive action and they bind to the oestrogen receptors the interactions between the oestrogen receptors and isoflavones activates the oestrogen response units present inside of the nuclear membrane and lowers the level of binding site of endogenous oestrogens present in the different tissues. Oestrogen receptors are the members of steroidal family of intracellular receptors present in the nuclear membrane. These receptors have two isoforms i.e. alpha and beta receptors. Oestrogen Alpha receptor maintains the estrogenic activity in the uterus and other oestrogen target tissues. Oestrogen beta receptor plays a role in the ovary, Brain and other tissues in the body. These isoflavones are competitively binds to the ER Alpha receptor and have agonistic activity but it is lower than the 17-beta-estradiol on flip side isoflavones also blocks the estrogenic activity by binding to certain extent of the complete ERs^{37, 38}. Isoflavones has also been used as a supplement of hormonal replacement therapy in post-menopausal women. Genistein is one of the soy isoflavone. Affinity of genistein to ER β is about 20-30 times greater to ER- α when compared to the 17- β -estradiol. Similitude of additional isoflavones to bind to ER is 100-500 times lower than 17- β -estradiol³⁸. Isoflavones are gradually used as a supplement of hormonal replacement therapy in post-menopausal women³⁸.

Dairy Products: In a study it is concluded that if a minimum of three glasses milk by women in a day it decreases infertility risk by 70 percent in those women and it is also said that if dairy products with

high fat content is taken then the chances of the occurring ovulatory infertility is decreased³⁹.

Milk: Consumption of non-fat milk caused an increase in concentration of insulin like growth factor-1 along with insulin in circulation. This IGF-1 activate the Leydig cells by binding to insulin receptors and thus help in proliferation of Sertoli cells and studies shown that insulin can increase the concentration and motility of sperms present in rats and this skimmed milk also helped to protect spermatogenesis in mice with type-1 diabetes by improving insulin level⁴⁰.

Yogurt: Coenzyme Q10 provides advantageous outcomes in curing infertility in males. This compound may play an important role in protecting sperm membrane because of oxidative stress ultimately leads to maintenance of integrity of spermatozoa Yogurt derived from MFSP known to possess ability to scavenge free radicals at high rate So, every secured sample of yogurt can be used as supplement of coenzyme Q10⁴¹.

Meat Products:

Fish: Fishes are composed of large amount of two types of omega-3 PUFA, those are: Docosahexaenoic acid and Eicosapentanoic acid. According to some estimations if we consume a single fatty fish in a day then we get about 900mg of DHA and EPA in a day. These DHA and EPA have actions like dilating the blood vessels and bronchi. It is found that at the time of maturation of sperm, there is accumulation of docosahexaenoic acid in the membrane of sperm which is linked to the higher motility of sperm, and it is also linked to the higher sperm concentration. DHA present in membrane of sperms able to influence events like fusion of oocyte and spermatozoa, capacitation. PUFA also effects events like maturation of oocyte and implantation of embryo. PUFA helps to maintain integrity and stability of sperm cell membrane and flexibility of membrane of sperms occurs by due to participation of PUFA, this is necessary for sperm acrosome response thus helps during fusion of gametes. PUFAs regulate different biochemical cascade like pathway of 3-phosphatidylinositol kinase that helps to control acrosome reaction of sperms. But sometimes these PUFA may have a negative influence on activity of phosphatidylinositol 3-kinase^{42, 44, 45}.

In female's omega-3 fatty acids improve balance in hormone levels and improves the implantation of embryo thus help in fertility. Women who consume omega-3 fatty acids at high levels leads to increased levels of circulating estradiol and also quality of embryo is improved. In studies it is shown that women who have higher levels of omega-3 fatty acids caused a greater chance to get pregnancy and in males omega-3 fatty acids help in maintaining the health of sperms⁴³.



FIG. 1: FOODS USED IN AUGMENTING FERTILITY

TABLE 1: SUMMARY OF NUTRITIVE FOODS USED IN THE TREATMENT OF FERTILITY

Fruits		
Example of Food	Bioactive components	Nutritive Benefit
Mango	Vitamin-C, Vitamin-E, phenolic acids Flavonoids, carbohydrates, folates and zinc, Quercetin.	Quercetin directly interacts with the coenzyme-Q binding site present in the membrane of mitochondria; this interaction will ultimately suppress production of super oxides and ultimately increase ATP production and fertility in males.
Avocado	Fatty acids MUFA [Mono saturated fatty acid, folate, Vitamin E, Potassium	Vitamin E enhances the quality of sperm and the endometrial lining, while folate promotes ovulation and healthy cell division. Avocados are good for naturally boosting fertility because they include healthy fats that balance hormones, lower oxidative stress, and improve reproductive health.
Walnuts	Omega-6-fatty acids, Omega-3-fatty acids, Alpha-linolenic acid (ALA)	Vitamin E, polyphenols, selenium, and zinc present in nuts will increases the antioxidant capacity on sperms and sperm production, quality, also prevents the sperm DNA fragmentation in males. In females they cause follicle development that leads to the high-quality oocytes and helps in the embryo development.
Grapes	Polyphenols	Bioactive compounds with antioxidant and anti-inflammatory effects, like polyphenols, may help protect reproductive health. Grape seed extract, for example, has improved fertility in hens.
Vegetables		
Tomato	Carotenoids, Phenolics and Beta-carotene, Lycopene	Incubation of sperms together with lycopene reduced the damage to mitochondria of sperm due to oxidation and lycopene also prevents spermatozoa mortality thus improving Anti-apoptosis capacity of sperms.
Spinach	Ferulic acid	It activates cGMP led to improvement in metabolism and motility of sperms in echinoderms like sea urchin and also mammals. Development of Foetus. Quality of sperm also improves. It also increases the male sex hormone levels (Testosterone) Isoflavones are gradually used as a supplement of hormonal replacement therapy in post-menopausal women.
Beet Root	Caffeic acid	
	Boron metal	
	Nitrates	
Soyabeans	Stilbenes (Resveratrol), Lignans (Matairesinol), Isoflavones (biochanin A,	

daidzein and genistein) coumestans (4-methoxy coumestrol and coumestrol		
Dairy Products		
Milk	Insulin Growth Factor-1 (IGF-1) present in non-fat milk	IGF-1 activate the Leydig cells by binding to insulin receptors and thus help in proliferation of Sertoli cells and studies shown that insulin can increase the concentration and motility of sperms present in rats.
Yogurt	Co enzyme Q 10	This compound may play an important role in protecting sperm membrane because of oxidative stress ultimately leads to maintenance of integrity of spermatozoa.
Meat Products		
Fish	Docosahexaenoic acid Eicosapentaenoic acid	Maturation of oocyte and implantation of embryo. PUFA helps to maintain integrity and stability of sperm cell membrane and flexibility of membrane of sperms.

CONCLUSION: In summary, the use of nutrient-dense foods to treat infertility is becoming more widely acknowledged as a fundamental component of a comprehensive strategy for reproductive health. Ovulatory function, sperm quality, hormonal balance, and the general uterine environment can all be greatly impacted by a well-balanced diet that is high in particular micronutrients and macronutrients. Antioxidants such as zinc, selenium, folic acid, Ascorbic acid (vitamin C) and Tocopherols (vitamin E) are essential for defending reproductive cells against oxidative stress and promoting DNA synthesis. Oily fishes are good sources of omega-3 fatty acids, which help to augmenting vascularity to reproductive organs and reduce inflammation. Additionally, controlling blood sugar levels with a low-Glycemic diet can help with ailments like PCOS, which is common etiological factors of infertility. Diet is not a panacea, but when combined with traditional medical care, it can be a potent, patient-empowering tactic. Comprehend and following these dietary guidelines into practice can improve overall health, increase fertility, and give individuals and couples a solid support network while they work towards conception. The ongoing emphasis on adequate nutrition highlights how crucial it is to maximizing reproductive potential.

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