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REVIEW PAPER

Health Food for Soldiers

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ABSTRACT

One of the biggest challenges the Indian army has been confronting is maintaining its troops at tough high altitude battle field of more than 18,000 feet. At such high altitude, troops are exposed to inclement weather, perilous altitude, difficult terrain and psychological problems arising out of being isolated from the main land miles away from their near and dear ones. Under such circumstances if an army has to keep its soldiers physically fit and in high morale to fight against the enemy and protect the integrity of the nation, it has to be provided with palatable, healthy and adequate nutritious food. Hence, it is essential to formulate health foods keeping in aid the real need of the soldiers to alleviate such situations also. There are hundreds of phytochemicals reported to possess therapeutic effects. The health foods containing these phytochemicals can be classified in to six categories, viz. health promotion - to improve health on a regular basis, sickness prevention - to prevent seasonal climate related problems, disease control - to fight early symptoms of health problems, supporting - to complement the primary treatment and to combat adverse side effects of harsh drugs during sickness, recuperating - to revive and regain vitality after sickness, rejuvenating - to repair damages and body malfunctions to restore health.

Keywords: Health; Soldier; Nutrition; Sickness; Food

1. INTRODUCTION

'Let your food be thy medicine', proclaimed Hippocrates, the Father of Medicine, who compiled a list of over four hundred herbs and their uses. Fruits, vegetables, herbs, spices and other nutritional substances are the oldest form of medicine known to man. While modern or 'allopathic' medicine is barely a century old, the practice of natural medicine using' nature as a pharmacy can be traced back through all of the ancient civilisations. Over many centuries, man's experiment with plants has yielded a vast stock of natural medicines that heal many ailments, and almost always without harmful side effects. Many pharmaceuticals are still derived from the extracts of wild plants, such as digitalis from the purple foxglove flower. Amazingly enough, less than one per cent of the more than two hundred and fifty thousand plant species on earth have been studied for their medicinal properties[1].

The common health problems associated with the addies at high altitudes such as altitude sickness, UV radiation from sun, hypoxia, etc. coupled with the difficulty in maintaining regular fresh food supplies to the Army personnel, do pose dangers in as much as enemy troops do[2-4].

Our body with the help of the right nutrition has the natural ability to defend, repair and restore health. Food therapy has a recorded history of more than 3,000 years and is the most basic treatment in Chinese medicine to prevent and cure disease. It is the preparation of medicinal food dishes, using selected food ingredients and superior herbs, to derive the necessary components to treat specific health conditions[5-7].

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1.1 Normal Body Changes at High Altitude

Certain normal body changes such as breathlessness during movement, hyperventilation, increase in urination, wakefulness during the night, strange dreams etc. happen in most people who travel to high altitude. Gaining height slowly while taking time to adjust to new altitudes is the best known way to avoid illness. Other measures to help prevent altitude sickness include keeping warm and drinking plenty of water to maintain the body warm and hydrated[8]. A diet high in complex carbohydrates is generally believed to be the best food for high altitudes.

1.2 Altitude Illness

At high altitude, atmospheric pressure is reduced. The consequent reduction in oxygen pressure can lead to hypoxia (i.e. reduced supply of oxygen to the tissues). Altitude sickness mainly occurs at heights above 2500 m. The main indication of altitude sickness during ascent is a painful headache with loss of appetite, nausea or vomiting, dizziness, sleeping problems, fatigue or weakness, confusion, unsteady walking[2]. The condition occurs because of the body trying to acclimatise with lower oxygen levels. In rare cases, the illness can lead to life threatening conditions such as pulmonary oedema which causes fluid retention in the lungs; symptoms of which include

breathlessness while resting, persistent cough and an unusual chesty sound and cerebral oedema. Symptoms of cerebral oedema, which can be fatal due to fluid accumulation in the brain, include irrational behaviour, confusion and a staggering gait. Patients with this condition need immediate evacuation and medical attention.

1.3 Ultraviolet Radiation from the Sun

The ultraviolet (UV) radiation from the sun includes UVA (wavelength 315 nm – 400 nm) and UVB (280 nm – 315 nm) radiation, both of which at high doses are damaging to human skin and eyes. Exposure to UV radiation, particularly UVB, can produce severe debilitating sunburn and sunstroke, particularly in light-skinned people. Exposure of the eyes may result in acute keratitis ('snow blindness'), and long-term damage leads to the development of cataracts. Long-term adverse effects on the skin include: development of skin cancers (carcinomas and malignant melanoma), mainly due to UVB radiation and accelerated ageing of the skin, mainly due to UVA radiation, which penetrates more deeply into the skin[7].

1.4 Hypothermia

Hypothermia occurs when the body loses heat faster than it can produce it and the core temperature of the body falls. It is easy to progress from very cold to dangerously cold due to a combination of wind, wet clothing, fatigue and hunger, even if the air temperature is above freezing. Symptoms of hypothermia are exhaustion, numb skin (particularly toes and fingers), shivering, slurred speech, irrational or violent behaviour, lethargy, stumbling, dizzy spells, muscle cramps and violent bursts of energy. It is best to dress in layers; silk, wool and some of the new artificial fibres which are all good insulating materials. A hat is important, as a lot of heat is lost through the head [8-9]. A strong, waterproof outer layer is essential, as keeping dry is vital. Carrying basic supplies, including food containing simple sugars to generate heat quickly, and lots of fluid to drink would help in emergent situation. A space blanket is something all travellers in cold climates should carry.

A number of measures can be adopted to prevent acute mountain sickness: Ascending slowly, frequent rest days, spending two to three nights at each rise of 1,000 metres. In case of ascending at high altitude by trekking, acclimatisation takes place gradually and the body is less likely to be affected than landing directly to high altitude. It is always wise to sleep at a lower altitude than the greatest height reached during the day if possible. Also, once above 3000 m, care should be taken not to increase the sleeping altitude by more than 300 m per day. The mountain air is dry and cold and moisture is lost as one breathes. Evaporation of sweat may occur unnoticed and result in dehydration. Eating light meals, containing high-carbohydrate provides sustained energy need and avoid alcohol as it may increase the risk of dehydration.

2. FOODS FOR ALLEVIATING STRESS SITUATIONS AND VARIOUS DISEASES

There are hundreds of phytochemicals reported to possess therapeutic effects. They may be put into food use. The health foods containing these phytochemicals can be classified in to following categories:

i. Health promotion - to improve health on a regular basis.
ii. Sickness prevention - to prevent seasonal climate related problems.
iii. Disease control - to fight early symptoms of health problems.
iv. Supporting - to complement the primary treatment and to combat adverse side effects of harsh drugs during sickness.
v. Recuperating - to revive and regain vitality after sickness.
vi. Rejuvenating - to repair damages and body malfunctions to restore health.

Eating foods that exert medicinal effects is the most effective way in promoting good health. In a quest for good health, it is strongly recommended to include medicinal foods in the diet. They are less -expensive than drugs, have least adverse side effects, are easy to make, and extremely nutritious and tasty. They also make meals more interesting. Medicinal foods can delay the onset of degenerative diseases and defy ageing.

Foods being the fuel of the body also act like medicine, thereby boosting immune system and warding off illnesses such as cancer and heart disease. But because foods are exceedingly complex packages of chemicals and compounds, they don't deliver a single biological punch, as do pharmaceutical drugs designed to accomplish a specific purpose. Instead, the right foods can have a much broader effect on a variety of health problems.

2.1 Fruits, Vegetables and Spices with Health Benefits

A number of fruits, vegetables and herbs are known to impart beneficial effects towards health if taken in the proper fashion and in right proportions[10]. Beneficial effects of some of the fruits/vegetables followed by the medicinal herbs which are used for different diseases :

Apple: Reduces cholesterol, contains cancer-fighting agent known as antioxidant. High in fibre, helps prevent constipation and suppresses appetite.

Asparagus: A super source of glutathione, a powerful antioxidant. In studies, glutathione has been shown to act against at least thirty carcinogens.

Avocado: Can help prevent clogging of arteries; dilates blood vessels. Lowers cholesterol. Its main fat, monounsaturated oleic acid, acts as an antioxidant, slowing the buildup LDL (low-density lipoprotein) cholesterol. Also one of the richest sources of glutathione.

Banana: Soothes the stomach. Strengthens the stomach lining against acid and ulcers, and lab tests show that bananas can act like antibiotics. Very high in potassium, thus may help regulate high blood pressure.

Barley: Long considered a heart medicine in the Middle East. Reduces cholesterol levels and contains antioxidants that may help prevent cancer.

Beans: (Including navy, black, kidney, and pinto beans, and lentils) Studies show that eating a half cup of cooked beans daily may reduce cholesterol levels as much as 10 per cent.

Also helps to regulate blood-sugar levels. Rich in fibre. Bean consumption is linked to lower rates of prostate and breast cancer.

Bell Pepper: Rich in antioxidant vitamin C. Therefore, a great food for fighting off colds, asthma, bronchitis, respiratory infections and cataracts, as well as angina, atherosclerosis (damaged, clogged arteries) and cancer.

Blueberries: Act as an unusual type of antibiotic by keeping infectious bacteria from attaching to the lining of the urinary tract, helping to prevent recurring urinary tract and bladder infections. Also contain chemicals that curb diarrhea.

Broccoli and Cauliflower: Abundant in antioxidants. Broccoli is rich in anticancer agent such as vitamin C, beta carotene and quercetin. Both broccoli and cauliflower are considered effective in helping to prevent lung, colon, and breast cancers. These cruciferous vegetables can speed up removal of estrogen from the body, perhaps helping to prevent hormone-related cancers such as breast cancer. Rich in fibre. Compounds in broccoli also help prevent ulcers.

Brussels Sprouts: Packed with antioxidants and other cancer-fighters including indoles, chemicals that may help protect against colon cancer.

Cabbage: Contains numerous anti-cancer and antioxidant compounds. Seems to suppress the growth of colon polyps, a precursor to colon cancer. In studies, eating cabbage more than once a week cut men's colon cancer odds by 66 per cent.

Carrot: A super source of beta carotene, the antioxidant reputed to help prevent numerous health problems, including heart attacks, cancer, and cataracts. One study showed that the beta carotene in a daily cup of carrots slashed stroke rates in women by 40 per cent and heart attacks by 22 per cent. One medium carrot's worth of beta carotene daily may cut lung-cancer risk in half, even among formerly heavy smokers.

Celery: Celery compounds have been shown to lower blood pressure in animals. High in certain anticancer compounds that have been shown to detoxify carcinogens, including cigarette smoke. Tests also show that celery may act as a mild diuretic.

Chili Pepper: Works well for the blood clot-dissolving system, opens sinuses and air passages, and acts as a decongestant. Most of its pharmacological activity is credited to capsaicin, the compound that makes the pepper taste hot. Capsaicin is a potent hypocholesterolemic agent and so also a potent painkiller, alleviating headaches when inhaled. Putting hot chili sauce on food may even speed up metabolism, burning off calories.

Cinnamon: A strong stimulator of insulin activity; thus, potentially helpful for those with adult-onset diabetes. Also seems to help prevent blood clots.

Clove: Long used to dull the pain of toothache. Contains compounds that act like aspirin.

Collard Greens: Full of antioxidant compounds, including lutein, Vitamin C and beta carotene. In animal studies, collards inhibited the spread of breast cancer. Collard-green consumption, like that of other green leafy vegetables, is associated with low rates of many cancers.

Corn: High in anticancer compounds called protease inhibitors, corn may help fight cancer and act as an antiviral agent.

Cranberries: Like blueberries, help prevent recurring urinary tract and bladder infections. Also believed to be effective in inhibiting viruses.

Dates: High in natural aspirin. Also high in fibre; have a laxative effect. Dried fruits, including dates, are linked to lower rates of certain cancers, especially pancreatic cancer.

Eggplant: Eating eggplant may lower blood cholesterol and help counteract some of the detrimental effects high-fat foods have on the blood. Lab tests show that eggplant also seems to act as an antibacterial agent and as a mild diuretic.

Garlic: A proven antibiotic that has been shown to kill bacteria, fungi, and intestinal parasites. Also shown to lower blood-cholesterol levels, seems to act as an anticoagulant. Garlic also contains multiple anticancer compounds, antioxidants, and immune-system boosters. A good cold medication, garlic also acts as an effective decongestant and anti-inflammatory agent.

Ginger: Used for centuries in Asia, ginger is a proven anti-nausea remedy. Also, relieves the inflammatory pain and swelling of rheumatoid arthritis and osteoarthritis.

Grapefruit: Contains a pectin that's been shown to lower blood-cholesterol levels and blood pressure in animals. High in antioxidants, especially disease fighting Vitamin C, grapefruit may help prevent stomach and pancreatic cancer.

Grapes: A rich storehouse of anti-cancer compounds, red grapes are high in the antioxidant quercetin. Red-grade skins also contain resveratrol, which seems to lower bad-type LDL cholesterol.

Kale: An amazingly rich source of antioxidant compounds. High in beta carotene, and contains more lutein than any other vegetable tested. Kale is a member of the cruciferous family and contains anticancer chemicals called indoles, which may help prevent estrogen-linked cancers.

Melon: (cantaloupe and honeydew) May help prevent blood clots. Orange melons, such as cantaloupe, also contain high levels of beta carotene.

Mushroom: Esteemed in Asia as a heart medicine and cancer preventive. Tests show that compounds in Asian mushrooms, such as shiitake, may help inhibit cancer as well as viral diseases, and can lower cholesterol levels. One study showed that fresh or dried shiitake mushrooms cut cholesterol by up to 12 per cent when eaten daily. .

Mustard: (Including horseradish) Helps relieve congestion from colds and sinus problems, and acts as an antibiotic. Revs up metabolism: One study showed that ordinary yellow mustard seemed to increase metabolic rate, helping to burn more calories.

Nuts: High in the antioxidant Vitamin E, nuts help prevent cancer and heart disease. Almonds have a high concentration of oleic acid, which may help reduce cholesterol and protect arteries. Brazil nuts are extremely rich in selenium, an antioxidant linked to lower rates of both heart disease and cancer. And walnuts contain ellagic acid, another cholesterol-reducer.

Oats: Oats can help lower cholesterol and stabilize blood-sugar levels. Compounds in oats also seem to suppress nicotine cravings.

Onion: Including chives, shallots, scallions, leeks) Containing exceptionally strong antioxidants, onions have

been shown to help prevent cancer in animals. The onion is a rich source of quercetin, a potent antioxidant known to inhibit stomach cancer. Onions may also help prevent atherosclerosis and blood clots, and even high fight bacterial and viral infections.

Orange: A complete package of cancer-inhibitors, including antioxidants such as Vitamin C. Specifically tied to lower rates of pancreatic cancer. Because of their high vitamin C content, oranges may also help ward off breast and stomach cancer, asthma attacks, atherosclerosis, and gum disease. Some studies show that Vitamin C deficiencies may also inhibit fertility in some men.

Parsley: Rich in antioxidants, parsley can help detoxify carcinogens, including those in tobacco smoke. Parsley also acts as a diuretic.

Plum and Prune: Compounds in these fruits may act as antibacterial and antiviral agents. High in fibre, these fruits work as laxatives.

Potato: (white) Contains cancer-fighting protease inhibitors. Also high in potassium.

Raspberries: As do other berries, raspberries help fight infections, and may help prevent some cancers. Also help curb nausea.

Rice: (White and brown) Like other seeds, contains anticancer protease inhibitors. Effective against diarrhea. Rice bran helps lower cholesterol levels and may help prevent formation of kidney stones.

Soybeans: Rich in compounds that act like hormones and thus seem to ward off cancer, especially estrogen-linked breast cancer. High soybean consumption may be one reason rates of breast cancer and prostate cancers are very low among the Japanese. In studies, soybeans lowered blood cholesterol levels substantially. And animal studies showed that soybeans seem to deter and help dissolve kidney stones.

Spinach: As with other green leafy vegetables, consumption of spinach is linked with lower rates of cancer. A super source of antioxidants, including folate, beta carotene and lutein, for example.

Strawberries: Rich in antioxidant Vitamin C as well as high in fibre. Studies show that compounds in strawberries act like antiviral agents. And other studies link regular strawberry consumption to lower rates of all types of cancer.

Sweet Potato: A blockbuster source of beta carotene. One half-cup of mashed sweet potatoes is higher in beta carotene than a medium carrot. Also high in fibre.

Tea: (including black, oolong, and green tea) Tea acts as an antibacterial, antiulcer agent, cavity-fighter, even an anti-diarrheal agent. In animal studies, tea and tea compounds seemed to inhibit various cancers. Tea drinkers appear to have lower risk of atherosclerosis and stroke.

Tomato: A major source of the antioxidant lycopene. tomatoes are linked to low rates of certain cancers, including bladder cancer, a rich source of glutei acid helps in wound healing.

Watermelon: Like the tomato, watermelon contains high levels of lycopene and glutathione, an antioxidant and anticancer compounds.

Wheat: High-fibre wheat bran has formidable anti-cancer potential. One or two daily servings of wheat-bran cereal has been shown to suppress pre-cancerous polyps that can develop into colon cancer. In women, wheat bran also appears to prevent breast cancer by diminishing supplies of estrogen circulating in the body.

2.2 Utilisation of Medicinal Herbs in Health Food Formulations[17-21]

In addition to fruits, vegetables and spices, the healthy promoting properties of which are systematically worked out, there are numerous herbs reported to possess the same type of activities. Few of them are enumerated here[11-15].

Few plants are known to possess CNS active. Hence the active components of there plants may possess CNS-active properties. One such plant is *Pongamia Pinnata* (karanj). The extracts of the seeds of this plant was found to reduce the sleeping time, Probably by stimulation of the hepatic micro enzyme system. Similar properties were exhibited by the roots. The alcoholic extract of *Bacopa monniera* facilitates the acquisition, consolidation and retention of memory as evidenced by the behavioural response in albino rats. The behavioural responses observed include foot shock noticed brightness discrimination, etc. Two saponins designated as bacosides A and B are responsible for the facilitatory effects of *Bacopa monniera*. The bacoside also attenuated the amnesia produced by immoblilisation induced stress. Hence the formulation of foods using these herbs may be highly useful in adaptation at high altitude. A preliminary clinical study confirmed the safety of the bacosides in healthy volunteers at single and multiple doses administrated over a period of 4 weeks. Another herb reported to possess protection of hypothermia is *Hacosonia inasmis* commonly as Mehendi.

(i) Psychoactives

The leaf extract of *Azadirachta indica* commonly known as *neem* exhibits *annseiolytic* effect comparable to diazepam at low doses[16]. Other psychoactive plants are *Vitex lencoxylon, Nelumbo nueifera* (lotus) and the roots of *Panax ginseng*. *Panax ginseng* exhibits aggression inhibitory effect. Health foods based on these plants might be helpful in alleviating anxiety related disorders at altered situations in remote areas, high altitude, desert, etc. *Panax ginseng* should potentiation of phenobarbitore sleeping time i.e. CNS depressant effect. The extracts of petroleum ether, benzene, chloroform, acetone and ethanol of the leaf of *Abies pindrow* Royle commonly known as silver fir showed potentiation of sleeping time. Leaves of Indian *Ginkgo biloba* exhibits consistent and significant anxiolytic activity ginkgolic acid conjugates, t-alkyl salicylates isolated form the leaves of the plant are the potential agents responsible for the anti-depressing effect.

(ii) Analgesics

Analgesic (pain-reliever) A substance that relieves or reduces pain. Also referred to as *anodyne* (Internal) Iporuru, t*ayuya, manaca, vassourinha, mulungu* (External) Copaiba, andiroba, kalanchoe, Abuta, amargo, *amor seco, anamu, andiroba, Brazilian peppertree, carqueja, catuaba, chanca piedra, chuchuhuasi, embauba, erva tostao, gervao,*

guacatonga, guarana, guava, jurubeba, macela, muira puama, nescafe, nettles, passionflower, scarlet bush, suma, boldo, cip6 cabeludo, clavo huasca, epazote, espinheira santa, fedegoso, graviola, guaco, iporuru, juazeiro, mullaca, quinine, sarsaparilla, simarouba, Balsam, Brazil nut, cashew, Gossypin, a bioflavonlid found in the yellow petals of *Hisbiscus citifolins* (*Bhadwaji*) has anti coniceptive activity similar to morphine. This plant exhibits multi neurotransmitter properties. Hence it is potential candidate as a constituent of health foods. In addition, *Azadiracnhta* shows analgesic properties. *Ceropgia juncea* Roxb commonly known as *bhutambi* has shown analgesic effect. Other plant material embiiting analgesic effect is bark of *kanakachampa*

(iii) Antiinflammatory

The extract of the leaf of Vitex leucoxylon show significant inhibition of oedema and granulation tissue formation. The aqueous suspension of dried latex of *Arka* shows anti-inflammatory property in models. The roots and leaves of *palash* possess ocular anti-inflammatory activity. The gel formulation of *Butea fromdosa* reduces the intra oculare pressure. Triglyceride fraction of oil of *Ocimum sanctum* (*Tulsi*) offers higher protection against oedema and writhing. The methanolic extracts of the flowers of *champaka*. *Rasna* and some wild plants were found to possess significant anti-inflammatory activity.

(iv) Antipyrectics

The ethanollic extracts of *mahanimba, kanchana* and monkey puzzle show moderate to significant degree of antipyretic activity in rat model. The antipyretic activity is reported for *kalmeha, kamal,* etc.

(v) Cardiovascular System Active

Petroleum ether and methanolic extracts of the lead and oleoresin of *Araucaria bidwilli* shows delaying effect on bleeding and clotting times. Hence it has great potential in the formulation of anticoagulant foods. Gugulipid is and agent that has been studied of its hypolipidemic activity.

(vi) Antihypertensives

Bhauiamalaki is suggested being potentially diuretic, hypotensive and hyupoglycemica for humans. Hydroalcoholic extract of *Azadirachta indica* possess hypotensive effect. Abana, a polyherbal formulation lowers blood pressure.

Rutin, a flavonoid in sophora japonica reduces the infarct size and hence is known to be cardio protective. Bark extract of *Arjuna* was associated with an improvement in symptoms and signs of heart failure. Long term therapy shows beneficial effect to population of cardiovascular disorders.

There is a well known balm for human memory, and aquatic plant known as water hyssop. Passion flower is reported to a mildly antianxiety herb for peace full and worry free mind. It works best in thin, nervous and easily stressed persons.

Similarly there are numerous plants or their extracts reported to possess beneficial effect to various disorders and degenerative diseases in humans. There is lot of scope for formulation of health foods making use of these natural plant resources. In addition to the plants enumerated above, there are plants acting on respiratory system, anti-allergic plants, anti-profertility plants, plants acting on uro-genital system, gastrointestinal pro and anti-kinetic plants, cytoprotective plants, radioprotectives, and plants capable of modulating UV-light induced stress, immune active plants, etc. There are numerous reports of anti-cancer, anti-oxidative, anti-aging, anti-arrhythmic, etc.

3. REGULATIONS FOR MAKING HEALTH FOODS

Given the increasing evidence that foods can have beneficial physiological effects, in addition to traditional nutritional roles and assist in reducing the risk of diseases, a clear government policy on functional foods and nutraceuticals is needed. The goals of such a policy might be to :

(a) Help public promote and maintain good health and delay onset of chronic diseases
(b) Permit legitimate health claims
(c) Help food industry to increase its support to biomedical research and product development and
(d) Assist the food industry to pioneer functional foods and nutraceuticals for domestic and international markets. Before approval, the food must satisfy the following criteria[22-23].
(i) Contribute to the improvement of dietary habits as well as the maintenance and enhancement of health
(ii) The health benefits from the food or relative components should have a clear medical and nutritional basis
(iii) Appropriate consumption of the food or its constituents should be defined
(iv) The food and its constituents should be judged as safe
(v) The test methods for the physico-chemical properties as well as qualitative and quantitative determination of the constituents should be well defined
(vi) The composition of the product should not be significantly lower in nutritional components as compared to those in similar foods
(vii) The food should be consumed in the usual way, and on a daily basis, not occasionally, and
(viii) The product should be in the form of an ordinary food, not pill, capsule or other dosage form.

Once approved, the health benefits of the product may be stated on the label, but not in a misleading or exaggerated way. Manufacturers may not encourage over consumption of the food, give advice that might deter the consumer from receiving medical care or defame competitors or their products.

A significant driving force in the functional foods market place is consumer demand - the quest by consumers to optimise their health through food. The 'health race for health promoting ingredients' has been identified as the far most important trend in food industry, it has been found that the percentage of today's shoppers who believe that certain foods can help to reduce their reliance on drugs and medical therapies have increased significantly in just two years from 42 per cent to 52 per cent.

4. HEALTH FOODS MADE BY DFRL

A number of functional foods have been developed for health of the Armed Forces; exploiting the health benefits of some of under utilised medicinal plants such as *Aloe vera, Rhodiola rosea* and *Hyppophae rhamnoides* (seabuckthorn)[23].

The foods / food technologies developed for the health of the Armed forces have a good potential for civilian population as well. This is demonstrated by the interest shown by the population at large who are seeking the transfer of technology.

4.1 Performance Enhancement Drink (physical) Antifatigue Drink/Sports Drink

Aloe vera is known, since ages, for its health benefits and the plant is used as an ingredient in various cosmetics.

Aloe vera is also known to improve the blood circulation by aiding in supply of nutrients to cells. It has been shown that *Aloe vera* enhances the nutrient absorption across the endothelial cells to blood stream. These two important properties were utilised in developing *Aloe vera* pineapple drink to enhance the physical performance.

Sodium chloride, potassium chloride, dextrose, sugar malto dextrins, citric acid sodium citrate and permitted class II preservatives were used as per the recommended levels. The developed product was evaluated for its sensory attributes with experienced panelists. The developed product had an average score of 7.5 on 9 point hedonic scale indicating 'very good' acceptability. The product was also analysed for physico chemical composition such as sugar, carotenoids, vitamin C, polyphenols flavonoids, glucomannnn, aloin and antioxidant activity. The aloin, the toxic compound was found to be nil.

The antioxidant activity was 70 per cent suggesting its vital role in reducing oxidative stress. The product was tested for its performance enhancing properties in rats which were allowed to swim until exhaustion and the results were compared with commercially available performance enhancers (sports drink). The swimming test was carried out for 15 days in rats. The result indicated significant increase in swimming time when compared to commercial and electrolyte drink. Approximately 28 per cent increase was observed in swimming time. The product has a shelf life of six months.

4.2 Low Calorie Spiced Aloe Beverage

India has earned the dubious distinction of being the world leader in having a huge diabetic population. Diabetes mellitus often simply referred to as diabetes—is a condition in which a person has high blood sugar, either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced. This high blood sugar produces the classical symptoms of polyuria (frequent urination), polydipsia (increased thirst) and polyphagia (increased hunger).

Low calorie Spiced *Aloe vera* beverage developed by the group aimed at reducing the blood sugar levels in the diabetes was first evaluated for its efficacy in the chemically induced diabetic rats. Diabetic rats after consuming the spiced low calorie *Aloe vera* beverage showed significant reduction in blood glucose levels, food intake water consumption and urine out put with no body weight loss. Positive results were obtained on consumption of the beverage on blood glucose levels and blood lipids significantly. The overall effect of the beverage showed antidiabetic property.

Clinical Trials: After establishing the anti-diabetic benefits of the low calorie spiced *Aloe vera* beverage in experimental animals, it was tested in human diabetic patients in different phases.

Phase I: Twelve diabetic patients were selected from among the staff of DFRL, Mysuru. The study was carried out for three months. Feelings of the people after the study were recorded.

Phase II: Encouraged with phase I studies, phase II study was carried out under the supervision of medical practitioner (MOU signed). A bigger size of population (n=50) was inducted after giving an advertisement in a local daily newspaper. It was found that low calorie aloe spiced beverage not only reduce blood sugar levels in diabetic patients when administered orally, but also regulated the dyslipidemia that associated with the patients.

4.3 Wound Healing

Aloe gel has been shown to effectively heal dermal wounds. Both topical and oral *Aloe vera* gel applications have been shown to significantly stimulate collagen synthesis in dermal wounds in rats. The average healing time was 18.19 days in the vaseline-gauze treated wounds and 11.89 days in the Aloe-treated wounds.

4.4 Antiulcerative *Aloe vera* based Fruit Spread

Aloe vera fractions were prepared to determine anti-ulcer rich fractions using column chromatography. The anti-ulcer fraction was confirmed by cyclo-oxygenase inhibitory activity and by measuring and *in vivo* anti-inflammatory studies. Anti-ulcerative colitis property of the *Aloe vera* fraction was studied in experimental rats and the colitis was induced by intra-rectal administration of 6 per cent acetic acid (4ml/kg body weight). Results revealed elevated level of myeloperoxidase activity in the colon and followed by the histopathological examinations. On infusion in *Aloe vera* fraction groups, acute inflammation was significantly suppressed. Colon and liver lipid peroxidation levels (MDA), conjugated dienes, and hydroperoxides showed significant increase associated with reduction in levels of glutathione (GSH), activity of superoxide dismutase (SOD), catalase glucose-6-phosphate dehydrogenase, glutathione peroxidase (GSH-Px) and glutathione S-transferase (GST) in acetic acid administered groups of rats. At the same time there was significant reduction in hepatic levels of acetic acid-induced raise in lipid peroxides and reverted these changes on the ingestion of *Aloe vera* fraction. The results of histology of the colonic section also showed amelioration in inflamed colon by the feeding *Aloe vera* fraction for 21 days. These studies provided evidence that *Aloe vera* fraction may be beneficial in patients with inflammatory bowel disease and colitis.

Aloe vera based fruit spread rich in glucomannan, flavonoids and other antioxidants was developed based on the above animal experiment. The overall acceptability was 8 on a 9 point hedonic scale with the shelf stability of 6 months.

4.5 *Rhodiola rosea* Capsules

Gelatine capsules of *R. rosea* root extract was manufactured by the aid of NKCA Pharmacy, Mysuru, India. Each capsule was of 250 mg strength. The word nutraceutical combines nutrition and pharmaceutical to mean that certain medicinal herbal extracts can be used as food supplements and preventive drugs. Thus incorporated bioactive ingredients in foods protect and/ or promote health and occur at the intersection of food and pharmaceutical industries. *Rhodiola rosea* root extract at the level of 200 mg/day has been evaluated for a few biological activities like anti-oxidant, anti-inflammatory, anti-bacterial, anti-fatigue properties. We have also observed that *Rhodiola rosea* root extract has the ability to enhance immune response in experimental animals. In the course of evolution, *R. rosea* has adapted to the harsh conditions of high altitude (extreme cold, low oxygen, little rainfall and intense irradiation from sun) by producing a group of powerful protective compounds that have diverse beneficial effects. This has been exploited to use *R. rosea* root extract as a food supplement for troops deployed in high altitude to combat physical and mental stress.

4.6 *Rhodiola rosea* Enriched Chocolate and Coffee

R. rosea enriched chocolate and coffee being a rich source of antioxidant polyphenols was enriched with dry *Rhodiola rosea* tincture extract/residue (RTE). Together with the stimulating effect, RTE enriched Chololate and coffee may help to increase immune response and fight stress. A panel of 50 selected judges evaluated the coffee in terms of color, aroma, taste, solubility and over all acceptability. *R. rosea* enriched coffee scored 7.7+0.6 on a 9 point hedonic scale in organo leptic evaluation.

4.7 Seabuckthorn Leaves Based Biscuits

Biscuits are very popular snack food which is available in different size, shapes and taste. Biscuits become the ideal travelling food since they stay fresh for long periods. Among the shrubs, seabuckthorn (*Hippophae rhamnoides* L., Elacagnacea) has received considerable attention due to its versatile applications. It was used as a medicinal plant in Tibetan and Mangolian traditional medicines. Since the 1950, many medicinal preparations of seabuckthorn from mild and materials have been clinically used to treat radiation damage, burns, viral inflammation and gastric ulcers in China and the former Soviet Republics. These plants are naturally grown in Ladakh region of Jammu and Kashmir, locally known as *Tsermang* or *tasru* – wonder plant. Biscuits prepared out of the leaves of seabuckthorn were found to contain good amount of antioxidants. The biscuits are rich in flavonoids and other phyto constituents and are useful in combating diabetes, cardiovascular problems, etc.

The effect of the biscuits was studied at high altitude in C-H-R animal models. The animals fed seabuckthorn biscuits mixed diet showed further improvement in adaptogenic activity as there was 37 per cent increase in time to attain Trec 23°C and 42 per cent faster recovery of Trec 37°C, in comparison to control rats fed normal feed. The recovery time of Trec 37°C of rats fed seabuckthorn biscuits mixed feed was significantly better even in comparison to animals fed on diet containing placebo biscuits. The freeze dried seabuckthorn leaf-extract powder incorporated biscuits are highly nutritive, rich in polyphenols and flavonoids. They are tasty and crunchy and easy to carry.

A number of baked foods like cakes, bun and rusk were also developed and evaluated. The details are given under

Seabuckthorn Cake: Freeze dried seabuckthorn leaf extract power incorporated cakes are tasty, soft, rich in antioxidants. Shelf-stability is like any other cake.

Seabuckthorn Buns: Seabuckthorn leaf enriched buns are filling, antioxidative, rich in polyphenols and fibre

Seabuckthorn Rusks: Seabuckthorn leaf enriched rusks are tasty, crunchy, healthy and curative. It is rich in antioxidants and dietary fibre.

Seabuckthorn Bread: Seabuckthorn leaf enrich bread is tasty, soft and rich in fibre and antioxidants. Shelf stability is like any other bread.

Seabuckthorn Jam: Seabuckthorn pulp enriched jam has pleasant colour, flavour, homogeneous with packed antioxidants and possess good cutting edge.

Seabuckthorn Jelly: Seabuckthorn pulp enriched jelly has attractive colour, uniform and glossy, free from discolouration due to oxidation, rich in antioxidants with pleasant flavour.

Seabuckthorn Squash: Seabuckthorn pulp-based squash have lovely colour, aroma and taste rich in antioxidants and spices with homogeneity. *Aloe vera* gel based squash is pleasant, tasty, rich in polyphenols and flavonoids and homogeneous.

Seabuckthorn Yoghurt: A fermented milk product is prepared by using strains of lactic acid bacteria blended with seabuckthorn fruit. It is easily digestible with enriched natural antioxidants and having the ability to protect and maintain the natural flora

Seabuckthorn Based Herbal Tea: Herbal teas are often consumed for their physical or medicinal effects, especially for their stimulant, relaxant or sedative properties. Different parts of Seabuckthorn especially the leaves are found to be rich source of vitamins, trace elements, polyphenols and flavonoids. The leaf extract of Seabuckthorn is known to possess a significant anti-inflammatory activity and has the potential for the treatment of arthritis. Hence herbal tea was developed utilising seabuckthorn leaves as a major ingredient. It has high quantities of polyphenols, which detoxify the free radical activities. The other ingredients were locally available cost-effective spices and herbs. A cup of seabuckthorn leaf tea is found to be refreshing, stimulating and stress relieving apart from being a thirst quencher and a soothing and relaxing with very fine aroma. This herbal tea mix has been studied for its protective effect against the toxic effects of an organochlorine pesticide, hexachlorocyclohexane and the hyper cholestrolemia. The study revealed that the tea mix has the potency to reduce the oxidative stress induced by and the cholesterol-induced hypercholesterlia in experimental rats. Sensory evaluation of seabuckthorn herbal tea showed a very good over all acceptability of 7.7 on a 9-point hedonic scale.

The tea mixture was evaluated for its free radical scavenging and antioxidant property *in-vitro*. To investigate further the ability of the tea to modulate DNA damage *in-vivo*, studies was carried out over acrylamide induced DNA

damage. A considerable amount of DNA damage was observed in acrylamide treated leukocytes. The comet tail length was measured using Image Pro Plus software. There was a significantly lesser DNA damage seen in acrylamide + tea mix treated leukocytes, where the comet tail length was 68.40 ± 10.60. A significant increase in the induction of micronuclei in the cells was observed in acrylamide treated group and there was reduction in the number of micronucleated cells in tea mix fed group of acrylamide treated rats, suggesting the protective effect of seabuckthorn leaf based herbal tea on free radical induced DNA damage.

5. CONCLUSION

Stress in turn has been found to be the causative factor for many health disorders. Operations in the glaciated environment of Siachen have opened a new chapter in the history of modern warfare. At high altitudes, whether civilian population or the Armed Forces, adaptation to the extreme environmental conditions, without long lasting serious health problems is extremely essential. Though effective medicines are available across the counter, their toxicological manifestations and side effects are the drawbacks. Hence we have developed physiologically active foods viz. low calorie spiced *Aloe vera* beverage, *Aloe vera* based fruit spread, Seabuckthorn based herbal tea and baked foods, *Rhodiola* based coffee, etc useful for combating diabetes, hypercholesterolemia, colon ulcer and other stress related disorders and diseases. These functional foods are developed after evaluating their potency in experimental rats. These technologies were transferred to different firms over a period of time will definitely help the human population

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