EFFECT OF SELECTED AYURVEDIC-HERBAL MEDICINES ON PERFORMANCE OF CARDIO-RESPIRATORY ENDURANCE

By

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CERTIFICATE

This is to certify that the work entitled "**EFFECT OF SELECTED AYURVEDIC-HERBAL MEDICINES ON PERFORMANCE OF CARDIO-RESPIRATORY ENDURANCE**" is a piece of research work done by **Mr. MADHAVAN N.,** under my guidance and supervision for the degree of Doctor of Philosophy in Physical Education in the University of Calicut, Kerala. The completed research study by the scholar is original of this kind and has not been carried out by any scholar in any other University.

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DECLARATION

I herby, declare that the thesis entitled "**EFFECT OF SELECTED AYURVEDIC-HERBAL MEDICINES ON PERFORMANCE OF CARDIO-RESPIRATORY ENDURANCE**" submitted to the University of Calicut for the award of the Degree of Doctor of Philosophy in Physical Education is a record of bonafied research work done by me under the guidance and supervision of **Dr. K.P. Manoj**, Assistant Director and Head, Department of Physical Education, University of Calicut, Kerala and it has not previously formed the basis for award of any degree, diploma, associateship, fellowship or other similar title or recognition of any other University.

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Madhavan N.

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CHAPTER I
INTRODUCTION

Success in sports is primarily depend up on genetic endowment in athletes with morphologic, psychologic, physiologic and metabolic traits specific to performance characteristics vital to a particular sport. Such genetically-endowed athletes must also receive optimal training to increase physical power, enhance mental strength and provide a mechanical advantage. When humans compete one another either in war or in sports, the competitors, by definition, seek to achieve an advantage over opponent and frequently they use drugs and other performance enhancing substances to gain the upper hand. However, athletes often attempt to go beyond training and use substances and techniques, often referred to as ergogenics, in attempts to gain a competitive advantage. Pharmacological agents, such as anabolic steroids and amphetamines have been used in the past, but such practices by athletes have led to the establishment of anti-doping legislation and effective testing protocols to help deter their use. Thus, many athletes have turned to various dietary strategies, including the use of various dietary supplements (sports supplements), which they presume to be effective, safe and legal.

According to surveys, athletes are major consumers of supplements and an important target group for the multi billion dollar supplementary industry. Health food stores, supermarkets, sports stores and the internet provide access to an increasing number of products, that claim to prolong

endurance, enhance recovery, reduce body fat, increase muscle mass, minimize the risk of illness or achieve other goals that enhance sports performance. It is understandable that, the claims of improved performance are attractive to athletes and coaches in elite competition, where very small differences separate the winners from the rest of the competitor. Athletes provide each other with testimonials or hearsay about the benefits attributed to supplements and sports food. Many athletes fear that, their opponents might have a secret weapon and even in the absence of scientific evidence to support the claims for a certain supplement they often feel compelled to use the product to maintain a certain level of performance on the playing field.

Most of the sports scientist are interested in supplements and sports food, as a part of their search for new strategies to enhance training effect, recovery and performance during competition. Many scientists has undertaken applied sport nutrition research, which has helped to develop new products and investigate the specific ways in which these products can be used to optimize performance. Unfortunately, the many challenges in undertaking such research mean that, it is impossible to keep pace with the number of new products that appear in the market. Thus, the majority of products used by the athletes are either untested or has failed to leave expectations in the preliminary studies that have been conducted. Scientists have a belief that well controlled research should underpin the promotion of any sports nutrition practice and are understandably frustrated because the producers of supplements often make impressive claims about their products

without adequate or, in some cases, any proof. In most of the countries, legislation regarding supplements or sports food is either minimal or un-enforced, allowing unsupported claims to flourish and products to be manufactured with little or no complaints to labeling and composition standards of which the athletes and coaches are unaware off.

The use of drugs and supplements by athletes to enhance performance and appearance is not new. The Berserkers of Norse Mythology used bufotein for stimulating effects. (Prokop, 1970). West Africans used *Cola acuminita* and *Cola nitida* for running competitions (Strauss and Curry, 1987). The ancient Greeks ate hallucinogenic mushrooms and sesame seeds to enhance performance (Wadler and Hainline, 1989). Roman gladiators used stimulants to overcome fatigue and injury (Wadler and Hainline, 1989). South American natives chewed coca leaves for centuries to increase endurance (Boje,1939; Hoberman,1992; Prokob,1970)

All nutrients essential for life are obtained from animal or plant food which we consume. Several nutrients are said to possess ergogenic potential for athletes under special circumstances for egs. carbohydrate loading for marathon runners. Other than essential nutrients, animal and plant food contain naturally occurring substances that are referred to respectively as zoo chemicals and phytochemicals (American Dietetic Association,1998). Herbs acts as a class of phytochemicals that may induce physiologic actions in the body conducive to enhanced physical performance.

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In the last few decades, sports have gained tremendous popularity all over the globe. The popularity of sports is still increasing at a faster pace and this trend is likely to continue in the future also. If the history of modern Olympic Games is looked into, it can be seen that the number of sportive disciplines in which the competitions are held at Olympic Games has increased steadily.

The area of competitive sports has gained much publicity and importance than any other areas. It has its own structure and organization, cadre of functionaries and a science which exclusively deals with this area. The principal aim of competitive sports is to prepare sports persons for giving elite sports performance. The area of performance sports is not merely a glamorous area of sports, it also fulfills certain valuable social functions due to which, it has been accorded high importance all over the world. It contribute towards the all round development of personality and enhances the horizons of awareness among the competing sports persons, with regard to the fact that they are representing particular states or countries of their origin. It inculcates in the youth a fervent desire to excel, for which, they discipline themselves in order to carry out rigorous training over a number of years. International champions become models to be emulated by their people especially by the youth. They are considered as National heroes and Nations feel proud of them. People rejoice at their victories and feel sad when they lose and in fact victory or defeat of their sports persons or teams is perceived as the victory or defeat of the nation.

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Competitive sports aim at elite sports performances and for that the physical capacities of sports persons are developed to extreme limits, which normally does not happen in other areas of human activity. As a result, competitive sports yield valuable knowledge about the limit to which human performance and various performance factors can be developed. It also leads to discovery of means and methods for improving various physical capacities to exceptionally high levels and this knowledge is fruitfully applied to other areas of sports and human activity.

Elite sport performance is indeed an aspect of complex human performance which do have several aspect or dimensions. Hence, several disciplines of sports sciences are required to work in a coordinated manner to explore the nature of sports performance, in order to fasten the process of giving elite sports performance. Several disciplines of Sports Sciences have been established during the second half of the 20th centaury and they are Sports Medicine, Sports Physiology, Sports Nutrition, Sports Training, Sports Biomechanics, Sports Psychology etc.

Among the four stages of life, the youthful stage is the most attractive one with ample health, strength and endurance one can achieve many laurels in one's life. But the fact is that, though it is the attractive stage of life which is short lived and cannot be brought back at any cost, the strength to fight against all odds including diseases comes down drastically. One of the reason for such a state is the improper nutrition i.e. intake of food. According to Nayak., (2000) it needs no emphasis that he/she who partakes compatible

food in proper quality and proper quantity and in time with a control over his/ her senses will not suffer from diseases.

Physical fitness is to the human body what fine tuning is to an engine. Fitness enables us to perform to our potential and can be described as a condition that helps us for a better look, pleasant feel and do our best. More specifically, it is the ability to perform daily tasks vigorously and alertly, with energy left over for enjoying leisure time activities and meeting emergency demands. It is the ability to endurence, to bear up, to withstand stress, to carry on in any circumstances where an unfit person could not continue, and is a major basis for good health and wellbeing.

Improving skill means that the performance of any motor task becomes more efficient, thereby reducing the time and level of effort required (Siedentop,1994). Sports in the present world have become extremely competitive and it is not the mere participation or practice that brings out victory to an individual. Therefore, sports activities are influenced by various factors, like Physiology, Biomechanics, Sports Training, Sports Medicine etc. All coaches and trainers, Physical Education personnel and doctors are doing their level best to improve the performance of the players.

The Physical Health of the human beings depends not only upon different systems such as the circulatory, respiratory, digestive, reproductive, nervous etc., but also on different organs of the human body. Among these systems, the circulatory and respiratory systems are important ones, because these systems have a direct relation with human life and hence, the failure of

these systems will be fatal. The main cause of a majority of pre-mature deaths in America are Cardio-vascular diseases and many who survive these diseases do have many limitations in their later lives.

Heart rate increases with exercise and hence increase is proportional to the work load. Generally speaking, a physically fit individual will have lower heart rate for a specified work load or in other words, at a given heart rate, the trained individual will be able to exercise at a higher work load than an untrained person.

Heart rate increases with oxygen consumption and hence is considered to be the most valid measure of cardio-respiratory fitness and is utilized in tests to predict oxygen consumption. Besides, heart rate provides a great deal of information about the body's reaction to exercise and is quick and easy to measure. Hence, it serve as a valuable tool to monitor the strenuousness of an exercise programme and provide a valid indictor of an individual's conditions in the measurement of cardio vascular fitness.

The Systolic Pressure of a trained person increases when he/she stands, while it is not so in a poorly trained person and in fact may even decreases. The heart rate, blood pressure and the breathing rate of an individual with good physical condition returns to the pre-exercise levels more quickly after exercise than at the rate an individual in a poor fitness condition.

Cholesterol is predominant in the form of plaques that clog up the arteries as a result the coronary arteries may not be able to supply the oxygen

needed by the heart muscle. This inability to supply myocardial oxygen is likely to occur when more oxygen is needed.

High blood pressure or rather hyper tension is the most common cardio-vascular disease and is related to coronary heart disease. Hence, stroke is the result of obstruction of blood vessels in the brain due to hemorrhages caused by high blood pressure. Physical inactivity, low cardio-respiratory fitness, diabetes, smoking etc. are the basic reason for the poor performance of these survival activities of human beings.

Endurance is a conditional ability and is primarily determined by the energy liberation processes. Hence, the ability of the human body to maintain a certain level of energy production forms the Physiological basis of endurance. Due to the high importance of health, training and competition and also due to its physiological determinates, it has been studied in great depth by the Physiologists.

Sharkey, (1986) defines endurance as the ability to resist fatigue. Singh, (1993) also defined endurance as ability to resist fatigue. Endurance, a very important ability in sports is often overlooked in several sports. Endurance, a product of all psychic and physical organs and systems is very much different from other motor abilities and also depends so much on the working capacity of the complete psycho-physical apparatus of humans. All other performance factors do depends only on one or more parts of this psycho-physical apparatus and as a result are directly or indirectly affected by endurance.

In sports, endurance ensures optimum speed or motor actions. The ability to maintain pace or tempo of an exercise during a competition is impossible without the requisite level of endurance. Good endurance also ensures high quality or skill of movement execution which finds expression in accuracy, precision, rhythm, consistency etc. Besides, under conditions of fatigue, the sports persons tends to lose motor co-ordination, concentration, mental alertness etc. and this clearly points out the importance of endurance for tactical efficiency. Apart from that, endurance activities have been found to be of high value for maintenance of good organic health, so as for increasing the general resistance against infection and for cure and treatment of various diseases and metabolic disorders.

Importance of Cardio - respiratory Endurance in Sports Performance:

An increased capacity to produce energy carrying oxygen is a prerequisite to many sports such as middle and long-distance running, cycling, rowing and swimming. Cardio-respiratory endurance is also important in team sports like football, basketball, soccer and rugby. Match analysis reveals that footballers have to cover distances of 7 to 11 km in a single game and match-play comprises of mostly low to moderate intensity activity with an average exercise intensity of 75% of maximum heart rate, and that heart rate exceeds 160 beats per minute for just 43% of the match play. Energy for activities at this level of intensity would predominantly be provided by the aerobic energy system. Most team games, including rugby and soccer are characterised as consisting of multiple high intensity bouts of

activity separated by periods of low to moderate activity. These high-intensity activities include sprints, jumps and tackle which are crucial to effective match performance. Although, these activities are fuelled by the anaerobic energy systems, researches have shown that, individuals with greater aerobic endurance require less recovery time in between repeated high intensity activities. Therefore, it is important to determine aerobic endurance in those sports because it is cardio- respiratory capacity that underpins the ability to play for 70 minutes and to recover between bouts of high intensity exercise.

To prevent the disease and to improve the health and/or physical fitness, different measures can be taken. Through the use of medicines or drugs the health can be preserved and there are different systems of medication viz. Allopathic, Ayurvedic, Homeopathic, Unani, Sidha, Naturopathic etc. India's conventional form of treatment is Ayurveda, in which herbal plants and spices are the important ingredients, as these plants and spices are found to have magical powers not only to cure the diseases but also to develop positive health and to improve Physical fitness.

Hence, Ayurvedic medicines can be given both to patients and to healthy individuals simultaneously. In patients, they cure diseases and in healthy individuals they prevent diseases and promote positive health.

Ayurvedic System of Medicine

Ayurveda originated in India long back during the pre-vedic period from Vedas, the most ancient text which gives more information on health

and diseases than any other documented knowledge. Later, in due course of time, Ayurveda said to be born out of intuition and revelation, developed into a complete system of medicine. The term Ayurveda means 'Science of Life' and deals elaborately with measures for healthful living during the various phases of the entire span of life. Besides, dealing with principles for maintenance of health, it has also developed a wide range of therapeutic measures to combat illness and these principles of positive health and therapeutic measures relate to physical, mental, social and spiritual welfare of human beings. This is one of the oldest formulated systems of medicine and widely practiced in India, Nepal, Bangladesh, Sri Lanka and Pakistan.

The basic theories of Ayurveda arise from the concept of *Tridosha*, that embraces the process of creation and evolution of Universe and laws of life. The function of the body is considered to be the complementary work of body, sense organs, mind and soul. Health in Ayurveda is defined as a well balanced happy state of being free from diseases consisting of four folds i.e. body, mind, external factors and natural intrinsic causes for which the treatment is done by the use of drugs, diet and practices. Ayurveda consider human beings in totality and in their relationship with the universe. Its approach is that disease occurs due to imbalance in the equilibrium of three *doshas*, restoration of which eliminates the disease and hence, it aims not only in curing the disease but also enhancing the body vitality to combat the disease and strengthen the immune system so that, the disease is automatically cured or prevented. Apart from that, Ayurveda also gives due consideration to

observation like daily routine, sleep, diet and gratification of senses. Thus, it can be said that, Ayurveda epitomizes the philosophy of complete and total healthcare and is not merely a medical science but is in fact a way of life.

Concepts and Principles of Ayurvedic System of Medicine:

According to Ayurveda, there are three basic constituents called *Doshas* in the physiological system and are the ultimate irreducible basic metabolic elements constituting the body and mind of living organisms. These *Doshas* are classified into *Vata, Pitta* and *Kapha* and correspond primarily to elements of air, fire and water which determine the life processes of growth and decay.

There are seven *Dhatus* or tissues in the body and they are: *Rasa*- body fluids, *Rakta*- blood, *Mansa*-muscular tissue, *Meda*- adipose tissue, *Asthi*- bone tissue, *Majja*- nerve tissue and bone marrow, and *Shukra*- generative tissue. There are also many waste products (*Malas*) in the body- stool, urine, sweat, nails, hair etc. Hence, according to Ayurveda health depends on a balanced state of all *dhatus*, *doshas* and *malas* both in quantity and quality.

Vata:

The biological air humour is called *Vata,* which is primarily dry, cold and light and is the most important or primary of three biological humours. *Vata* governs the other two and is responsible for all physical process in general and is said to sustain effort, exhalation, movement, equilibrium of tissues and coordination of senses. *Vata* is located in the colon, thighs, hips,

ear and bones and any increase in *Vata* causes debility, tremors, distention, constipation, insomnia and sensory disorientation.

Pitta:

The biological fire humour is called *Pitta* (bile) and is responsible for all the chemical and metabolic transformation in the body. *Pitta* exists in acid form and is essentially hot, moist and light and governs digestion, heat, visual perception, hunger, thirst, lusture, courage, stool, urine, eyes, skin, burning sensation and difficulty in sleeping. *Pitta* is located in the small intestine, stomach, sebaceous glands, blood and lymph and an increase in *Pitta* results in accumulation of internal heat or fever with inflammation and infection.

***Kapha*:**

The biological water humour is called *Kapha* (phlegm) that holds things together and provides substances which gives support and makes up the bulk of bodily tissues. It also governs emotional traits, passion, patience and modesty and is primarily cold, moist and heavy. These are groups of enzymes which are responsible for digestion and metabolism in the body and gives stability, lubrication and holding together of joints. Excessive *Kapha* causes depression of the digestive fire, nausea, lethargy, heaviness, white colour, chills, cough, difficulty in breathing and excessive sleeping. Higher *Kapha* content in the body causes accumulation of weight and gravity in the body, inhibits normal function and causes hypoactivity because of tissue accumulation.

According to Ayurveda, all objects in the universe including human body are composed of five basic elements called *Panchamahabhutas* namely, earth, water, fire, air and sky. There is a balance of these elements in different proportions to suit different structures and functions of the body and its parts. The tissues of the body are the structural entities, whereas, humours are the physiological entities, derived from different combinations of *Panchamahabhutas.* The food is considered to be basic building material of human body which gets processed into humours, body tissues and waste products and the equilibrium of humours is considered as to be healthy and any disturbances or imbalance leads to disease or sickness.

Diagnosis :

Ayurvedic methods of diagnosis are extremely simple. Stress is given on urine, stool, semen, vomiting, sneezing, yawning, hunger, thirst, tears, sleep or heavy breathing for diagnosis of a disease. It also stresses upon the use of a wholesome diet along with the use of drugs for successful treatment of diseases for which knowledge of the site of manifestation of the disease is also essential. Examination of the pulse is carried out with the help of radial artery and is carried out early in the morning when the patient is in empty stomach. The diagnosis examinations includes the following and they are examination of the urine, examination of the stool, general physical examination, examination of the tongue and eyes and examination of the skin and ear including tactile and auditory functions.

Treatment:

There are many different therapies applied in Ayurveda and can be grouped mainly into two as follows: (a) Tonification (Supplementation- make heavy) and (b) Reduction (Elimination- to lighten)

Reduction therapies decreases the body weight and are indicated for heavy weight, accumulation of toxins and aggravated or increased humours. It is indicated in acute stages of disease, when the attack is strong and primarily for *Kapha*. Tonification methods nourish deficiencies in body for chronic diseases and are indicated in debility or tissue weakness in which convalescence or after reduction methods have been used, primarily for *Vata*. *Vata* is treated by mild application of oils, mild sweating and purification methods, while mixed therapy is required for *Pitta and* is treated with the ingestion of ghee by purgation with sweet and cold herbs, by sweet, bitter and astringent food and herbs, by applying cool, delightful and fragrant essential oils, by amounting the heart with camphor, sandalwood, vetivert oils etc. On the other hand, *Kapha* is treated by strong emetic and purgation methods, by all kinds of exercises, by smoking of herbs and by doing physical hard work. Thus, treatment of diseases in Ayurveda is accomplished by any of the following methods:

(a) ***Shamana* therapy**: Elimination of vitiated *doshas* or humours is a process by which the vitiated *dosha* subsides or returns to normal without creating imbalance on other *doshas* is known as *shamana*. The administration of carminatives, digestives, creation of hunger or thirst, exercises and exposure to sun are classified under *shamana* therapy.

(b) ***Shodhana* therapy:** Emesis, purgation, enemas and blood letting come under *shodhana*. They are also called *Panchakarma*.

(c) **Surgical treatment:** Ayurveda advocates surgical treatment for those diseases which are not curable by medical treatment or in case where surgical treatment may provide immediate relief.

(d) **Diet:** Ayurveda lays emphasis on regulation of diet and other regimens as part of the treatment.

(e) **Drug sources**: In Ayurveda, drugs are classified depending on their taste, attributes. potencies, taste after digestion and therapeutic effect. In addition to single drugs, compound formulations are used for the treatment of diseases in the form of pills, powders, decoction, infusions, tinctures, alcoholic preparations, medicated ghee and fractional distillates. Several pharmaceutical processes are followed for the preparation of medicines for easy administration, making the products delicious to taste, easily digestible and assimilatable, therapeutically more efficacious, rendering them non toxic and more tolerable and for preservation for a long period of time. Ayurvedic drugs are administrated both externally in the form of ointments, dusting powders, collyrium, ear drops and eye drops and internally as tablets, pills, powders and syrups. Along with medicine, some regiments like sleep, walk, rest, physical excretion are also prescribed to the patient. Thus, herbal medicine play a major role in the treatment

of vitiated *Vata*, *Pitta* and *Kapha* and some of the plants used in Ayurvedic system of medicine is given in Table 1:1.

Table 1:1

List of the plants used in Ayurvedic System of medicine

Plant Name	Ayurvedic Name	Part used	Uses
Andrographis paniculata	Kalmegh	Leaves	Tonic, febrifuge, hepatic dysfunction
Aristolochia rotunda	Mudharaj	Tubers	Antitumour, antifertility
Artemisia indica	Nagdoona	Leaves	Antidiabetic
Bergenia ligulata	Pakhan bed	Root, leaves	Kidney stones, tuberculosis
Cassia absus	Chaksu	Seeds	Astringent, cathartic, ringworm
Cassia occidentalis	Kasundi	Seeds, leaves	Purgative, diuretic, tonic
Garcinia indica	Kokam	Oil	Skin diseases, cardio tonic
Hemidesmus indicus	Antamul	Root, whole plant	Fever, rheumatism
Mimosa pudica	Lajalu	Leaves, roots	Sores, piles, wounds General weakness
Momordica chrantia	Karela	Leaves, root	Antidiabetic
Mucuna pruriens	Kiwachh	Seeds	Anthelminthic, astringent

Nardosstachys jatamansii	Balcchar	Roots	Antiseptic, laxative, diuretic
Ocimum basilicum	Tulsi	Oil	Diaphoretic, carminative, skin diseases
Plumbago zeylanicum	Chitrak	Roots	Diaphoretic, abortificient
Saraca asoca	Ashoka	Bark	Rheumatism, urinary diseases
Taxus baccata	Talispatra	Leaves	Antispasmodic, aphrodisiac
Terminalia arjuna	Argun	Bark	Astringent, diuretic
Terminalia bellirica	Bahera	Fruits	Astringent, brain tonic, liver disorders
Tribulus terrestris	Chota gokhru	Fruits, roots	Diuretic, astringent, lithontriptic
Vitex agnus-castus	Rennuka	Leaves, roots	Laxative, galactogouge
Vitex negundo	Sambhalu	Fruits	Tonic, expectorant, febrifuge
Wrightia tinctoria	Inderjao	Root, bark	Flatulence, psoriasis

Herbs have been used throughout history to enhance physical performance, but, scientific scrutiny with controlled clinical trials has only been recently used to study such effects. The following herbs are currently used to enhance physical performance regardless of scientific evidence of effect: Chinese, Korean, and American ginsengs; Siberian ginseng, *mahuang* or Chinese *ephedra*; *ashwagandha*; *rhodiola*; *yohimbe*; *Cordyceps* fungus, *shilajit* or *mummio*; smilax; wild oats; *Muira puama*; *suma* (ecdysterone), saw palmetto berries; ß-sitosterol and other related sterols; and wild yams (diosgenin). Other herbs remain virtually untested. Future research on ergogenic effects of herbs should consider identity and amount of substance or presumed active ingredients administered, dose response, duration of test period, proper experimental controls, measurement of psychological and

physiological parameters (including antioxidant actions) and measurements of performance pertinent to intended uses.

Humans consume herbs to enhance their long-term endurance performance (egs. in running, cycling, rowing, swimming, walking, dancing, aerobics, cross-country skiing and mountain climbing), to induce muscular hypertrophy and strength (egs. for bodybuilding, weight lifting, wrestling, strength sports and track and field events) or to enhance performance in sport events, both skill sports and those that are recreational. Tradition, identity of ingredients, advertisements, personal endorsements, use by other athletes and the desire to succeed represent the extent of validation for most herbs used for physical performance.

Currently in the United States, herbs can be defined as drugs, food or dietary supplements. The Dietary Supplement Health Education Act (DSHEA) of 1994, which amended the Food, Drug and Cosmetic Act of 1938, defines dietary supplements as certain food items intended to supplement the diet that are not represented as conventional food. Besides, herbs or other botanicals and their extracts or concentrates are specifically mentioned as dietary supplements. To subject to DSHEA regulations, the statement “dietary Supplement” must appear on the principal display panel. DSHEA allows claims of structure or function to be made for dietary supplement products but not food and are based on the manufacturer’s interpretation of the scientific literature limited either to effects of ingredients on the body’s structure or function or on a person’s health or well-being. A

disclaimer to the effect that the Food and Drug Administration has not evaluated claims is mandatory to be present on dietary supplement labels that make structural or functional claims. Besides, product manufacturers and distributors are required to keep substantiation on hand, derived from reliable and competent scientific research, usually reported in peer-reviewed articles and texts, for any claims. Although, herbs can be conventional food or drug, all of the herbs described in this review are available as dietary supplements in the United States. Distributors of herbal products are also under the jurisdiction of the Federal Trade Commission (FTC), which monitors advertising for truthful statements that do not mislead. FTC guidelines for substantiation differ from DSHEA guidelines, a fact that may produce confusion as new regulations are enforced. It is hoped that distributors of herbal dietary supplements will disclose factual information based on peer-reviewed scientific literature, as the DSHEA intended. Other countries classify herbs as food, drug or both. In Germany, some herbs are prescription drugs that have passed stringent safety and efficacy requirements, but these drugs (herbs) are also available without a prescription. Herbal medicines are described in the German Commission E. Monographs, (Blumenthal et. al. 1998.) recently translated into English by the American Botanical Council. Herbal drug products to treat cerebrovascular deficiency that are made from *Ginkgo biloba* leaf extracts are one of the most frequently prescribed drugs in Germany.

HERBS AS ERGOGENIC AIDS

The herbs used most commonly at present to enhance physical performance and reasons for their use by consumers are discussed here. Some herbs are classified as adaptogens, i.e. they assist normalization of body system functions altered by stress rather than exerting a stimulatory effect (Kleijnen and Knipschild,1992). Persons who exercise often use adaptogens because exercise is considered as a form of stress. Various combinations of traditional Chinese herbs, traditional Indian (Ayurvedic) herbs or combinations of herbs are available in the market and targeted towards physical performance and are having lack of scientific substantiation and hence their use is found to be uncommon. Herbs are used to improve performance (both endurance and strength), improve recovery, maintain health during intense periods of exercise, build muscle mass and reduce body fat.

Herbs currently used to enhance physical performance

- ***Arctic rose*** *(Rhodiola crenulata, R. rosea*) Adaptogenic (antistress) properties, enhance occasional hypertension, endurance and strength.
- ***Ashwagandha*** (*Withania somnifera*) Adaptogenic (antistress) enhance endurance and strength.
- ***Asian ginseng*** (also Chinese, Korean) Adaptogenic (antistress) enhance possible adulteration with stimulant drugs.
- ***Panax ginseng*** endurance and strength contraindicated in hypertension.
- ***Chinese ephedra*** (mahuang) *(Ephedra sinica*) Central nervous system stimulant.

- ***Cordyceps*** (*Cordyceps sinensis*) Adaptogenic (antistress) enhance endurance and strength.
- ***Muira puama*** Testosterone-like effect (anabolic)
- ***Ptychopetalum olacoides*** Saw palmetto berries (*Serenoa repens*) Testosterone-like effect.
- ***Schizandra*** (wu-wie-tza) (*Schisandra chinesis*) Adaptogenic (antistress) enhance rare cases of appetite suppression, stomach endurance and strength upset.
- ***Urticaria. Shilajit*** (mummio) Adaptogenic (antistress) enhance endurance and strength.
- ***Siberian ginseng*** (ci-wu-jia) Adaptogenic (antistress) enhance rare cases of insomnia.
- ***Eleutherococcus senticosu*** endurance and strength contraindicates in high blood pressure.
- ***Smilax*** (sarsaparilla)) Testosterone-like effect (anabolic) German Commission E warns of gastric irritation and temporary kidney impairment and potential drug interactions with hypnotics.
- ***Suma*** (*Pfaffia paniculata*) Ecdysterone source, testosterone-like effect (anabolic)
- ***Tribulus terrestris*** (*Tribesta*n) increases testosterone (anabolic effects).
- ***Wild oats*** (*Avena sativa*) (combined with nettle root) testosterone-like effect .
- ***Wild yam***, Mexican yam (*Dioscorea villosa*) Testosterone-like effect (anabolic).
- ***Yohimbe*** (*Pausinystalia yohimbe*) adrenergic agonist, potentiate caffeine and not recommended for long-term use, increase male

performance. Contraindicated in liver and kidney diseases and in chronic inflammation of sexual organs or prostate gland.

Controlled studies of Asian ginsengs found improvements in exercise performance when most of the following conditions were true: use of standardized root extracts, study duration of eight week, daily dose of one gram dried root or equivalent, large number of subjects and older subjects. Improvements in muscular strength, maximal oxygen uptake, work capacity, fuel homeostasis, serum lactate, heart rate, visual and auditory reaction times, alertness and psychomotor skills have also been repeatedly documented. Siberian ginseng has shown mixed results. *Mahuan*g, ephedrine and related alkaloids have not benefited physical performance except when combined with caffeine. Other herbs remain virtually untested. Future research on ergogenic effects of herbs should consider identity and amount of substance or presumed active ingredients administered, dose response, duration of test period, proper experimental controls, measurement of psychological and physiologic parameters (including antioxidant actions) and measurements of performance pertinent to intended uses.

This information explores the scientific evidence for use of herbs and herbal extracts as ergogenic aids for humans who exercise. For this purposes, herbs can be defined as plants or plant extracts ingested for other than caloric or culinary benefit. Despite their long tradition of use by physically active persons, herbs have seldom been studied scientifically as a possible aid to physical performance. This will stop short of considering the effects of purified or synthesized compounds found in plant food and

classified as essential nutrients such as ß-carotene, tocopherol and ascorbate. This will not consider one of the most popular herbal extracts, caffeine, which has been studied extensively as an ergogenic aid, usually as the pure compound added to decaffeinated coffee so that doses are controlled. Caffeine has consistently shown ergogenic effects for both endurance and short-term exercise, as indicated by several reviews (Graham and Spriet, 1996). Only ginseng preparations and ephedrine alkaloids have only been studied repeatedly for their effects on human physical performance. Common physiologic measures of exercise which can consider performance as oxygen utilization, fuel homeostasis as well as several other measures of interest.

A variety of other herbs and herbal combinations have been used to enhance physical performance, but only a few have been tested on human clinical trials. Rationales for use of other herbs as well as herbs that have already been discussed. Other herbs generally fall into either of the two catogeries : 1) adaptogen or tonic (ginseng-like) or 2) anabolic (increase muscle mass). Tonic herbs are presumed to enhance aerobic performance and anabolic herbs are presumed to mimic or be converted in the body into anabolic steroids, mostly for use by bodybuilders and weightlifters. Although, anecdotal and testimonial “evidence” abounds, the rationale for use of other herbs is strictly hypothetical, conjectural or based on results of animal studies. *Shilajit (mummio)* is a tarry exudates from rock crevices found at high altitudes in the Himalayas and Caucasus mountains that is

derived from long-term humification of *Euphorbia* and *Trifolium* (clover) plants (Ghosal, 1988). Eastern European weight lifters have been using *mummio* as part of an "herbal anabolic stack" to promote better strength, recovery and muscular hypertrophy. Traditional Ayurvedic use of *shilaji*t as a tonic has some support from studies.

The investigator tries to find out the effect of '***Lakshadi' Choornam*** ***(powder***) for the enhancement of Cardio-Respiratory Endurance. This drug was traditionally used in ayurveda (Iyyar) by Kottkkal Aryavaidya Sala for strengthening and for enhancing the functioning of the thoracic region where our heart and lung lies. The medicine is even now prepared in large quantities for the treatment of specific diseases.

The Lakshadi Choornam (Powder) contains:-

1. 'Lakasha' Cateria Lacca or Coccus Lacca (Coccidian family)

Synonyms	:	Laksha (Sanskrit), Lac (English), Gala (Bangali), Lakha (Gujarathi), Combarakku (Tamil) Etc.
Taste(Rasa)	:	Astringent(Kasaya)
Property (Guna)	:	Snigdha.
Potency(virya)	:	Cold(sita)
Effect on Tridosa	:	Pacifies Pitta and Kapha (Singh, 2007)

Lac is a resinous substance usually of a reddish or dark brown colour, with a disagreeable smell and easily breakable with a cracking sound, deposited on the twigs of trees such as the Banyan, Croton, Acacia

and Peepul, by a small insect called the Carteria Lacca. Insect attack the young branches of the above mentioned trees and fix themselves to the branches; the female insect after ovipositor is effected dies, giving out from her body a reddish liquid which solidifies and forms a crust about an inch thick round the branch attacked; others again affirm that the sting of the insect effects the sap or gum of the trees, which forms the Lac. (Nadkarni, 2005).

2. 'Lajjalu' Mimosa Pudicca Linn (Luguminoseae Family)

Synonyms	:	Lajjalu, Namaskari (Sanskrit), Varaha (Karnataka), Humble Plant, Sensitive Plant (English) Total Vadi(Tamil), Thendermani (Malayalam), Lajalu (Hindi) Etc.
Taste(Rasa)	:	Bitter(Tikta) and Astringent(Kasaya)
Potency (Virya)	:	Cold
Effect on Tridosa	:	Pacifies Pitta and Kapha.

Mymosa Pudica is a diffuse under shrub 45-90cm long; stems and branches sparingly prickly and clothed with long week bristles from bulbous bases. Leaves are sensitive, petioles 2.5-5cm long, bristly; stipules 8cm long, acute and their rachises clothed with ascending bristles. Leaflets 12-20 pairs, base obliquely rounded and is distributed in tropical America and through out India. (Krirtikar and Basu, 2003).

STATEMENT OF THE PROBLEM

The purpose of the study is to analyze the effect of selected Ayurvedic-Herbal medicines on Cardio- respiratory Endurance performance.

DELIMITATIONS

1. The study will be delimited to three groups i.e. one experimental group, one placebo group and one control group.

2. The study will be further delimited to 45 subjects, 15 subjects in each group of 18-25 years of age.

3. The study will be further delimited to male Physical Education Students who are doing regular physical activity.

4. The study will be delimited to the following Ayurvedic-herbal medicine.

- "*Lakshadi Choornam*" which contain
  - *Kolarakku*—Laksha-"Lassifer Lacca""-Cocadian Family
  - *Thottavadi*—Lajjalu-"Mymosapudicca"-Laguminoseae family

5. The study was further delimited to the assessment of the following variables**.**

Biochemical Variables

1. Hemoglobin
2. Blood sugar (fasting)

3. Total Cholesterol

Physiological Variables

1. Resting Pulse Rate
2. Breath Holding Time
3. Respiratory Rate
4. Vital Capacity
5. Systolic Blood Pressure
6. Diastolic Blood Pressure and
7. Cardio-Respiratory Endurance

LIMITATIONS

1. The difference that exist among the subjects due to varied social, cultural and economic factors cannot be controlled and this is considered as a limitation of this study

2. The lifestyle and family background of the subjects selected cannot be controlled and this is considered as another limitation of this study.

3. The environmental changes and climatic conditions during the treatment period were not considered for the study**.**

HYPOTHESIS

1. It is hypothesized that there will not be any significant difference among different groups on Cardio Respiratory-Endurance of athletes as a result of the administration of Ayurvedic-herbal medicine.

2. It is hypothesized that there will not be any significant difference among different groups on Hemoglobin of athletes as a result of the administration of Ayurvedic-herbal medicine.

3. It is hypothesized that there will not be any significant difference among different groups on Blood Sugar of athletes as a result of the administration of Ayurvedic-herbal medicine.

4. It is hypothesized that there will not be any significant difference among different groups on Total Cholesterol of athletes as a result of the administration of Ayurvedic-herbal medicine.

5. It is hypothesized that there will not be any significant difference among different groups on Resting Pulse Rate of athletes as a result of the administration of Ayurvedic-herbal medicine.

6. It is hypothesized that there will not be any significant difference among different groups on Breath Holding Time of athletes as a result of the administration of Ayurvedic-herbal medicine.

7. It is hypothesized that there will not be any significant difference among different groups on Vital Capacity of athletes as a result of the administration of Ayurvedic-herbal medicine.

8. It is hypothesized that there will not be any significant difference among different groups on Systolic Blood Pressure of athletes as a result of the administration of Ayurvedic-herbal medicine.

9. It is hypothesized that there will not be any significant difference among different groups on Diastolic Blood Pressure of athletes as a result of the administration of Ayurvedic-herbal medicine.

10. It is hypothesized that there will not be any significant difference among different groups on Respiratory Rate of athletes as a result of the administration of Ayurvedic-herbal medicine.

DEFINITION AND EXPLANATION OF THE TERMS

Hemoglobin (Hb)

A protein in red blood cells that transports oxygen and carbon dioxide and gives blood it's red color. (www.webmd.com)

Blood Sugar (fasting)

The concentration of glucose in the blood, measured in milligrams of glucose per 100 milliliters of blood after fasting (www.answers.com)

Cholesterol

A fatty substance in which carbon, hydrogen and oxygen atoms are arranged in rings. (Howely and Franks,1997)

Resting Heart Rate

Resting Heart Rate is the number of times heart contracts in a minute while the body is at rest. (Hockey, 1985)

Respiratory Rate

Respiratory Rate is the number of breaths taken in a minute or number of inspiration or expiration in a minute. (Fox and Mathews,1981)

Breath Holding Time

Breath Holding Time is the duration of time through which an individual can hold the breath without inhaling or exhaling after a deep inhalation. (Strunkic,1981)

Vital Capacity

The amount of air that can be forcibly expelled from the lungs after breathing in as deeply as possible. (www.answers.com)

Systolic Blood Pressure

Systolic Blood Pressure is the highest arterial pressure measured during a cardiac cycle. It is the pressure in the artery after blood has been ejected from the left ventricle.(Linda, 1998)

Diastolic Blood Pressure

Diastolic Blood Pressure is the lowest arterial pressure measured during a cardiac cycle and is the pressure in the artery during ventricular relaxation when no blood is being ejected from the left ventricle.(Linda 1998)

Cardio-Respiratory Endurance

Cardio-Respiratory Endurance is the ability of circulatory and respiratory systems to supply fuel during sustained physical activity. (Howely and Franks,1997)

SIGNIFICANCE OF THE STUDY

Today's world of sports has been highly intensified with much fierce competition, as a matter of fact, every athlete tries to show his/her best performance. Many depend upon some kind of drugs which gives them some additional benefits. Hence, the result of this study will enable the utilization of ancient Ayurvedic and Herbal Medicines by the athletes, so as to enhance their performances in sports and games, accordingly, the practical contribution of research findings of this study will have the following significant contributions.

1. The findings of this study could be helpful to reveal the effectiveness of Ayurvedic –Herbal Medicines for the increase of cardio-respiratory endurance performance of athletes.

2. The findings of this study will help Physical Education Teachers and Coaches to know about the effect of '*Lakshadi Choornam*' on cardio respiratory endurance of athletes.

3. The findings of this study would add to the body of knowledge in the area of Sports Medicine and Exercise Physiology.

4. The findings of this study could be helpful to reveal the effectiveness of '*Lakshadi Choornam'* on the biochemical variables of athletes.

5. The findings of this study could be helpful to reveal the effectiveness of '*Lakshadi Choornam'* on Physiological variables of the athletes.

CHAPTER II
REVIEW OF RELATED LITERATURE

A careful search and exploration of the related literature with regard to the present study was essential to have an insight into the work already done. Very little research has been done in this area and the scholar with the available literature has gained valuable methodological hints from their procedures and findings that were of great importance and help in the course of this study.

Although many studies on Herbs and Herbal medicines have been carried out on general sedentary population and on patients, very few studies were found to be done on physical fitness, exercise and sports competitions not only related to other Herbs and Herbal medicines but also to the Herbal Medicine *Lakshadi Choornam* (powder)

DRUG REVIEW

Lakshadi Choornam (Kottakal Aryavaidyasala**)**

According to Kottakkal Aryavaidhyasala the above drug can be given in conditions like Cardio Respiratory injuries, bleeding, cough, asthma, tuberculosis, energy boosting etc.

Lassifer Lacca:

It is used in diseases caused by vitiation of blood, hiccough, cough, ulcer, diseases of the thoracic cavity, erysipelas, worm infestation and skin diseases, apart from that it improves complexion. (Singh, 2007)

According to Ayurveda and Siddha it is energy boosting, reduces *Kapha* and *pitta* (Nadkarni, 2005)

According to Unani, it can be given as a tonic for liver, kidney, stomach and intestine, haemostatic, resolvent of obstruction, jaundice, dropsy, besides reducing fat in adipose persons.

It is mixed with honey and prepared in the form of an electuary. Lac is a specific application for caries and diseased teeth. It is also used for inunctions in the form of several medicinal oils as *Laksadi Taila*. This oil is much used for inunctions in chronic fever and is applied to the chest in remittent fevers accompanied by cough, also used in lumbago, epilepsy and hysteria, as an application to the nape of the neck and spine. If this oil is applied to the body of pregnant woman, the fetus grows faster. A decoction of the Lac is also used in the preparation of other medicinal oils such as *Chandradi Taila*, *Angraika Taila* etc. Locally, Lac is used as a stimulant application to indolent, scrofulous and scorbutic ulcers.

Atharva Veda, Wisdom of Ancient Truth-seers of India is estimated to be several thousand years old, do clearly says that, both Lac as well as Lac dye were served as effective & valuable medicine. The Veda also reports that,

an extract of Lac made with water, which contains mainly Lac dye or Laccaic acid, was widely used on open wounds for quick healing and tissue regeneration. Besides, use of Lac in joining up of broken bones was also common. The Veda finally indicates slurry of Lac paste in water (which would mainly contain Lac dye) mixed with ghee (butter oil) and milk were commonly taken orally by sick or wounded persons so as to get back health. Thus this valuable old manuscript indicates that, Lac dye was not only safe enough to be used on open wounds but was also taken orally quite often to recoup health and vigor.

In *Atarvaveda*, mention is made of a decoction, *Lakshadi tail*, or 'Lac oil', said to be effective in curing chronic fevers and rheumatism.

Panini (550 B.C) mentioned the medicinal properties of Lac in his book, the Ashtdhyayi.

Mimosa Pudicca:-

According to Ayurveda, it cures '*Kapha*' biliousness, leprosy, dysentery, vaginal and uterine complaints, inflammations, burning sensations, fatigue, asthma, leucoderma and diseases of the blood. (Kirtikar and Basu, 2003).

According to Unani, it is useful in diseases arising from corrupted blood and bile, bilious fevers, piles, jaundice, ulcers, leprosy, smallpox etc.

A decoction of the root of this plant is considered on the Malabar coast to be useful in gravelliest complaints. The Ayurvedic *Vidyans* of the

Coromandal side of India prescribe the leaves and root for cases of piles and fistula.

In Konkan, the leaves are rubbed into a paste and applied to hydrocele; and their juice, with equal quantity of horse's urine, is made into an *anjan* (eye) so as to, be used to remove films of conjunctiva by setting up an artificial inflammation. Besides, the juice of the leaves is used to impregnate cotton wool for a dressing, in any form of sinus.

In Guiana, the leaves are used as a powerful soporific; a light infusion is given as a bitter tonic and the seeds and roots are used as emetic; the latter is irritant and even toxic in large dose.

In Brazil, the root is used as an emetic; the leaves are given in scrofula.

The leaves and stem in combination with other drug are recommended for the treatment of snake bite (Bavanaprakasha, Rasaratnakara, Yogaratnakara) and scorpion-sting (Rasaratnakara, Vaidyvinoda).

The whole plant is used medicinally in Cambodia. Internally it is prescribed for vesicle calculi. Externally it is used in edema, rheumatism and tumor of the uterus.

The juice of the leaves of Mymosa with tender coconut water is used to be given to kids who suffers from bronchial asthma and was also used to be given in conditions such as for dibates, skin diseases, allergy etc. (Neshamani, 2000)

Ganguly et. al. (2005) conducted a study on the effect of Mimosa Pudicca root extract on vaginal estrous and serum hormones for screening of antifertility activity in albino mice. Several plants are traditionally used as birth control agents by the rural people in India. Mimosa Pudicca is one of the folk medicinal plants commonly used as antifertility agent in some places in India. The present work was carried out to evaluate the claimed antifertility effect of the plant by carrying out pharmacological studies with the root extract of the plant.

Air-dried roots of Mimosa Pudicca were extracted using methanol. Dried methanol extract of the root was administered orally to Swiss albino mice for 21 consecutive days. Estrous cycle, reproductive hormones (prolactin, estradiol and progesterone) and number of litters produced were studied in both control and extract-administered groups by using standard methods. Phytochemical studies of the methanolic root extract were carried out using qualitative and thin-layer chromatography methods.

The results do shows that, Mimosa Pudicca root extract, when administered orally at a dose of 300 mg/kg body weight/day, prolonged the length of the estrous cycle with significant increase in the duration of the diestrous phase and reduced the number of litters in albino mice. The number of litters was increased in the post treatment period. The analysis of the principal hormones (prolactin, estradiol and progesterone) involved in the regulation of the estrous cycle showed that the root extract altered gonadotropin release and estradiol secretion. Hence the conclusion drown do

indicates that, the root extract of Mimosa Pudicca has antifertility effect and it prolongs the estrous cycle and disturbs the secretion of gonadotropin hormones in albino mice. The decreased level in the proestrus and estrus stages in the extract-administered group when compared with those of control animals indicates, the disturbance of estrous cycle and ovulation through suppression of FSH.

Valsala et. al. (2002) conducted a study on the effect of Mimosa Pudicca root powder on oestrous cycle and ovulation in cycling female albino rat, Rattus norvegicus. Mimosa Pudicca root powder (150 mg/kg body weight) when administered intragastrically, altered the oestrous cycle pattern in female Rattus norvegicus. Nucleated and cornified cells were absent in all rats. The smear was characterized by leucocytes only, as in dioestrus, which persisted for 2 weeks. There was a significant reduction in the number of normal ova in rats treated with the root powder when compared with the control rats and a significant increase in the number of degenerated ova.

Campbell, (1979) conducted a study on Potassium and Calcium in the motor organ of the sensitive plant Mimosa Pudicca localization by Ion microscopy. The ion microscope was used to study potassium and calcium distributions in the main motor organ of Mimosa Pudicca. The cortex of the motor organ has two cell types differing in location, structure and ion distribution. Histochemical features portrayed in ion micrographs were plainly correlated with structures seen in the light and electron microscopes.

Prasad et. al. (1975) studied the regeneration of peripheral nerve in young growing albino rats. The sciatic nerve of each animal was crushed with the help of artery forceps. They were divided in three groups containing equal number of animals and were treated either with total extract of Lajjawanti or hydrocortisone.The process of regeneration was studied histologically, electro physiologically and the number of axons was also counted at each interval. The results of this experiment showed that the regeneration of the nerve was enhanced by30-40% on *Lajjawanti* treated animals.

REVIEWS RELATED WITH OTHER HERBAL MEDICINES

Relevant literature regarding the area of present exploration has been obtained from experts in the field of Ayurvedic-medical profession, related books, journals, sports magazines, newspapers etc and is briefly categorized below.

Plants provide us with most of the nutrients essential for life. Other than essential nutrients, plant food contain naturally occurring substances, referred respectively as phytochemicals. Herbals, which are derived from leaves, bark, berries, roots, gums, seeds, stems or flowers of plants, also contain numerous phytochemicals thought to have nutritive or medicinal value.

Kochhar and Nagi, (2005) conducted a study on the effect of supplementation of traditional medicinal plants on Blood Glucose in Non–Insulin-dependent diabetics. The effect of supplementation of a powdered mixture of three traditional medicinal plants—bittergourd, jamun seeds, and fenugreek seed (raw and cooked form) on blood glucose was studied in 60 non–insulin-dependent male diabetics. The patients were divided into two groups of 30 each of which patients of group I were given the raw powdered mixture in the form of capsules; the patients of group II were given this mixture in the form of salty biscuits. Daily supplementation of 1 g of this powered mixture for a 1.5-month period and then a further increase to 2 g for another 1.5 months significantly reduced the fasting as well as the postprandial glucose level of the diabetic patients. A significant decrease in

oral hypoglycemic drug intake and decline in percentage of the subjects who were on hypoglycemic drugs were found after the 3-month feeding trial. It was concluded that 2 g of a powdered mixture of traditional medicinal plants either raw or cooked form can be successfully used for lowering blood glucose in diabetics

Liang et. al, (2005) conducted a study for a period of eight week supplementation of *Panax ginseng* extract (6g/day) for enhanced performance on treadmill running time, based on serum levels of antioxidant enzymes and was attributed to decreased oxidative stress. However, this one-group study involved a control pre-test followed by a post-test after the eight-week supplementation period and no placebo was utilized.

Neychev and Mitev, (2005) conducted a study on the effect of *Tribulus terrestris* on athletes. Extract of 20 mg/kg body weight, daily for four weeks was found to have no effect on serum testosterone or androstenedione. Also, in a double-blind, placebo-controlled study, *Tribulus terrestris* supplementation exerted was found to have no effect on body weight, body composition, maximal strength or muscular endurance in resistance-trained males during training.

Kuriyan and Rajendran, (2005) conducted a study on the effect of supplementation of Coccinia Cordifolia extract on newly detected diabetic patients. *Coccinia indica* (synonym *Coccinia cordifolia*) a herb growing abundantly in India, has been used in the traditional treatment of diabetes mellitus. However, carefully controlled studies of its efficacy are lacking.

This study aimed to evaluate the effectiveness of *Coccinia* on blood glucose levels of incident type 2 diabetic patients requiring only dietary or lifestyle modifications. The study was a double blind, placebo control, randomized study trial. Sixty incident type 2 diabetics (aged 35 – 60 years) patients from St. Johns Medical College Hospital, Bangalore, India were selected a subjects. The subjects were randomly assigned into the placebo or experimental group and they were provided with 1 gm of an alcoholic extract of the herb for 90 days. Anthropometric, biochemical, dietary and physical activity assessment were carried out at baseline and were repeated on the 45th day and the 90th day of the study. All the subjects were provided with standard dietary and physical activity advice for the control of their blood sugarlevel.

There was a significant decrease in the fasting, post prandial blood glucose and glycosylated hemoglobin of the experimental group when compared to the placebo group. The fasting and post prandial blood glucose levels of the experimental group on the 90th day significantly decreased by 16% and 18% respectively. Besides, no significant changes were observed in the serum lipid levels.

Bock et. al. (2004) found that an acute dose (200milligrams) of *Rhodiola rosea* improved time to exhaustion by 3% on a cycle ergometer. But, on the other hand, there was no significant effect was found following four weeks of supplementation with 200 milligrams daily. Apart from that, there was no effect on maximal strength, various measures of reaction time or

movement time. Besides, using combinations of such herbals have also been shown to have no ergogenic effect.

Herbold et. al. (2004) reported that 17 percent of female collegiate athletes used herbal/botanical supplements. Herbal dietary supplements are marketed to physically active individuals for a variety of reasons, including energy increases, inducing weight loss, promoting muscle growth or inducing other physiological or metabolic responses that may enhance exercise performance. Some sports drinks and sports bars contain herbals as well. Research supports beneficial medicinal effects of specific herbs for specific health problems, as documented in Herbal Medicine: Expanded Commission E Monographs (Blumenthal et. al. (2000)) and WHO Monographs on selected Medicinal Plants (WHO 1999). Unfortunately, however, with a few exceptions research investigating the ergogenic effects of herbal supplements are limited.

Parcell and Smith, (2004) conducted a study on the effect of supplementation with *Cordyceps Sinensis* (CordyMax Cs-4) to examine the effects on ventilatory threshold and endurance performance in endurance-trained cyclists. Twenty-two male cyclists participated in 5 weeks of supplementation with CordyMax Cs-4 tablets (3 g/d). Training intensity was maintained by weekly documentation and reporting throughout the 5-week period. Subjects completed a VO^2 (peak) test and work-based time trial prior to and following the supplementation period. It is concluded that 5 weeks of

CordyMax Cs-4 supplementation has no effect on aerobic capacity or endurance exercise performance in endurance-trained male cyclists.

Pittler and Ernst, (2004) reviewed the research on numerous dietary supplements marketed for weight loss, including various herbals and found that none (with the possible exception of *ephedra*) have shown evidence beyond a reasonable doubt that they are effective for reducing body weight.

Willoughby, (2004) reported that 1200 milligrams/day of C*ystoseira canariensis* supplementation during 12 weeks of resistance training had no effect on serum myostatin levels nor did it have any effect on muscle mass, muscle strength or body fat.

Curtis Prior, (1999) conducted a study on the Chinese Ginkgo tree the world's most ancient extract, originated two hundred million years ago and the source for *Ginkgo biloba* leaf extract. *Ginkgo biloba* is believed to exert its mode of action when its active ingredients, the flavonoids and terpenoids, work in concert. One of the tissue level effect is stimulated release of endothelium-derived relaxing factor, which may enhance muscle tissue blood flow through improved microcirculation.

Allen et. al. (1998) conducted a well-controlled study and reported that no significant effect of either Panax ginseng or a standardized ginseng extract on cardiovascular, metabolic or psychologic responses to either submaximal, maximal or supramaximal exercise performance capacity. The

results do indicates that, ginseng in its various forms does not enhance exercise or sport performance.

Winslow and Kroll, (1998) conducted a study on the earliest evidence of human use of plants for healing dates back to the Neanderthal period and today, various modern medicines may be classified as herbals. Now, herbals are regulated as medicine in some countries like India and Germany, but as dietary supplements in others. Currently in the United States most herbals are regulated by the Dietary Supplement Health and Education Act (DSHEA), more like food ingredients than drugs. However, given the pharmacological effect of various herbals, some health professionals are emphasizing the need for regularizing standard herbal therapy.

Lim, (1997) evaluated the effect of a breakfast meal containing 10 gm of dried hot red pepper on energy substrate use in male runners during rest and exercise (cycling at about 60 percent VO^2max). For the red pepper trial, plasma epinephrine and non epinephrine concentrations were significantly elevated after 30 min, but not at 60 and 150 min of rest. The hot pepper meal significantly elevated the respiratory quotient (RQ) and blood lactate levels at rest and during exercise, but there was no effect on oxygen consumption or energy expenditure during rest or exercise. These results suggest that, contrary to the theory of glycogen sparing, hot red pepper ingestion stimulates carbohydrate oxidation at rest and during exercise. Besides, it was also found that hot red pepper ingestion before exercise could decrease endurance

performance in athletes due to associated muscle and/or liver glycogen depletion.

CHAPTER III
METHODOLOGY

This chapter deals with the selection of subjects, selection of variables, selection of the tests, Criterion measures preparation of the herbal-medicins, the experimental design, reliability of the data, orientation of the subjects, collection of data, administration of the herbal-medicines and the statistical techniques used for analyzing the obtained data.

SELECTION OF SUBJECTS

For the purpose of the study, 45 athletes who were students of the University of Calicut undergoing professional course in Physical Education were selected as subjects. Only those students who have volunteered themselves for acting as subjects were selected and the age of the subjects ranged between 18 to 25 years. The subjects were informed about the nature of the study and their written consent were also taken before involving them as subjects in this study. The subjects were later randomly assigned to a supplementation group, a placebo group and a control group under double blind condition.

All subjects were residing in the university hostel leading routine lives and were doing the same kind of physical exercise for five days a week. Their average Physical characteristics are shown in table 3.1.

Table 3:1

The anthropometric data of the subjects selected for the study

Parameters	**Total (N=45) (Mean)**	**Supplementation Group (Mean) N=15**	**Placebo Group (Mean) N=15**	**Control Group(Mean) N=15**
Age (years)	22.25	22.48	22.83	22.42
Weight (Kg)	62.42	63.41	62.20	61.49
Height (Cm)	172.0	171.27	170.21	172.45
BMI (Kg/ m^2)	18.62	17.23	17.69	17.84

The investigation was carried out after seeking necessary permission from the head of the Department of Physical Education, University of Calicut. The Subjects were also informed that they were free to withdraw their consent in case they felt discomfort during the course of their participation in the study.

SELECTION OF VARIABLES

The researcher have had a through search of the available literature and had discussion with various experts in Ayurveda before the selection of this problem. The feasibility like availability of the medicines, the procedures and the possible outcomes were extensively analyzed before the problem was finalized. After analyzing the various factors associated with the problem, the following variables were selected for this study.

Physical Fitness	Cardio-respiratory Endurance
Biochemical	Hemoglobin
	Blood Sugar
	Total Cholesterol
Physiological	Resting Pulse Rate
	Respiratory Rate
	Breath Holding Time
	Vital Capacity
	Systolic Blood Pressure
	Diastolic Blood Pressure

- The important Biochemical variables selected such as Hemoglobin, Blood Sugar and Blood Cholesterol are not only closely related to human health and physical performance but also do depends a lot upon the consumption of food items.

- Since, Resting Pulse Rate, Respiratory Rate, Breath Holding Time, Vital Capacity and Blood Pressure are certain parameters or rather external signs of Cardio- Respiratory Endurance, they were also selected as variables for this study.

SELECTION OF THE TESTS

Standard tests were conducted to measure the various variables of this study. The selected variables and their respective tests and instrument used are presented in table 3:2

Table 3:2

The list of selected variables and their respective
Test and instrument used

Sl. No.	Variable	Test and Instrument used
Physical Fitness Variable		
1	Cardio- Respiratory Endurance	12 minute Run /walk test (Cooper Test)
Bio chemical Variable		
2	Hemoglobin	Tested at a standard Medical Lab
3	Blood Sugar	Tested at a standard Medical Lab
4	Total Cholesterol	Tested at a standard Medical Lab
Physiological Variable		
5	Resting Pulse Rate	Palpation of radial artery at wrist
6	Respiratory Rate	Observing the raise and fall of the Chest
7	Systolic Blood Pressure	Sphygmomanometer
8	Diastolic Blood Pressure	Sphygmomanometer
9	Breath Holding Time	Observing the duration of holding the breath
10	Vital Capacity	Spirometer

CRITERION MEASURES

The criterion measures for the selected variables were

1. Hemoglobin was recorded in grams percentage.(gm%)

2. Blood Sugar was recorded in milligrams of deciliter.(mgs/dl)

3. Total Cholesterol was recorded in milligrams of deciliter. (mgs/dl)

4. Resting Pulse Rate was recorded in numbers.

5. Systolic Blood Pressure was recorded in milligrams of mercury (mm/Hg)

6. Diastolic Blood Pressure was recorded in milligrams of mercury (mm/Hg)

7. Vital Capacity was recorded in litres.

8. Breath Holding Time was recorded in seconds.

9. Respiratory Rate was recorded in numbers.

10. Cardio-Respiratory Endurance was recorded in metres.

EXPERIMETAL DESIGN

The experimental design used for this study is a random group design involving forty five subjects, who were later randomly divided into three groups of fifteen each. One group was the experimental group, one placebo group and the last one the control group. The experiment was carried under double blind condition. The herbal-medicines were prepared and packed under the direct supervision of a registered medical practitioner in Ayurveda,

who only knows which capsule contained the herbal-medicine and which is placebo. Thus, neither the subjects nor the investigator have had any idea of the experimental group and the placebo group in this double blind design and hence the subjects of the experimental group and the placebo group were of the impression that they were all taking herbal-medicines.

PREPARATION OF THE HERBAL-MEDICINES

Preparation of the *Lakshadi Choornam*

" Lajjalu smarase sammyak
Sapthvaram subavitham
Laksham pishtua cha thannire
the choornammadhuna lihyath"_

*(*Iyyar*)*

One kilogram of "Laksha" ("Lassifer Lacca") was titrated in one litre juice of "Lajjalu" (mimosapudica) about seven times and was later dried, powdered and packed into capsules**.**

Preparation of Placebo

Normal wheat powder is prepared and packed in capsules**.**

ORIENTATION OF THE SUBJECTS

The investigator explained to the subjects participating in this study, the purpose of the study, the administration of the medicines, the collection of data and their role in this study. No information was given about the placebo

used in this study. The investigator also briefed about the various physical, biochemical and physiological tests used in this study..

RELIABILITY OF THE DATA

Reliability of data was ensured by tester's competency and instrument reliability.

Tester's Competency

All the measurements excluding the biochemical variables in this study were taken by the investigator with the help of assistants. From the research point of view, it is very important to be familiar in using the instrument and hence, the investigator had undergone training under an expert, inorder to ensure the reliability of measurements taken. After a series of practice sessions, the tester's competency was statistically analyzed and established by using the test retest method. Since the correlation coefficient values were very high, the tester's competency in taking measurements were accepted. The biochemical variables were tested in a reputed Medical laboratory by qualified lab Technicians and hence the results of biochemical variables were reliable enough for the study. The correlation coefficient values obtained for the various tests for testing the tester's competency is presented in the table 3:3.

Table 3:3
Coefficient of Correlation done on the Test
Retest Scores to ascertain the Competency of the Tester

Sl. No.	Tests, Methods and	Variables	Coefficient of

	Instrument Used	Measured	Correlation
1	Palpation of radial artery at wrist	Pulse Rate	0.90*
2	Observing the rise and fall of the chest	Respiratory Rate	0.91*
3	Wet Spirometer	Vital Capacity	0.94*
4	Observing the total time for holding the breath	Breath Holding Time	0.93*
5	Sphygmomanometer	Systolic Blood Pressure	0.91*
6	Sphygmomanometer	Diastolic Blood Pressure	0.92*
7	Running or walking for 12 minutes	Cardio-Respiratory Endurance	0.94*

***** Significant at 0.01 level of Confidence as the required value is 0.77

Since the obtained 'r' values were much higher than the required values, the data collected by the tester for the study were ascertained as reliable**.**

Instrument reliability

The instrument Wet Spirometer, Sphygmomanometer, Stop watches etc. for measuring the physiological variables were all having ISI standard and manufactured by reputed companies. Besides, were being used in Research Laboratories. Thus, the instruments used in this study were reliable enough for the purpose of this study**.**

COLLECTION OF DATA AND ADMINISTERATION OF THE HERBAL-MEDICINES

The control group consumed nothing while the experimental and placebo group consumed the Ayurvedic-herbal medicines and the placebo respectively. Besides, both the experimental and placebo groups continued their own routine physical activities for 45 days. The drugs were administered by the investigator himself everyday under the direct supervision of a medical practitioner in Ayurveda and were asked to consume the drugs in front of the investigator and practitioner then and there. The pre-tests were conducted 24 hrs. before the experiment and the post-tests were conducted 24 hrs after the experiment. The dosage of the Ayurvedic-herbal medicines and placebo given to the subjects were decided after seeking expert advice from the medical practitioner.

Estimation of Biochemical Variables

Estimation of Hemoglobin

The Hemoglobin of the subjects were tested at Kottakal, Aryavaidya Sala Clinical laboratory and the units were recorded in grams%.

Estimation of Total Cholesterol

The Total Cholesterol of the subjects were tested at Kottakal, Aryavaidya Sala Clinical laboratory and the units were recorded in mgs/dl.

Estimation of Blood Glucose

The Total Blood Sugar of the subjects were tested at Kottakal, Aryavaidya Sala Clinical laboratory and the units were recorded in mgs/dl.

Measurement of Physiological Variables

Resting Pulse Rate:-

Purpose:

To calculate the number of heart beat per minute under resting condition.

Procedure:

For assessing the Resting Pulse Rate, a stop watch ($1/100^{th}$ of a second) and a pencil is used. The subject were asked to lie down on a table. The thumb is placed on the carotid artery and the stop watch is switched on. The Resting Pulse Rate for 1 minute were taken three times and the average was taken as the score.

Scoring:

The average number of Pulse Rate per minute was taken as the test score. (Johnson and Nelson, 1986)

Respiratory Rate:-

Purpose:

To calculate the number of breaths per minute under resting condition.

Procedure:

Respiratory Rate was measured by counting the rise and fall of the chest for one minute. When the subject became familiar with the room temperature and attained normal breathing, the subject was asked to have a breath normally for one minute. The investigator stood near to the subject observed and recorded the readings by palpating the chest.

Breath Holding Time:-

Purpose:

The objective was to measure the ability of the subjects to hold the breath for a longer time**.**

Equipment:

A stop watch with calibration of $1/100^{th}$ of a second, score sheet and a pencil were used to administer the test.(Cooper, 1978)

Procedure:

The subject stood at ease and inhaled deeply after which the breath is held for a length of time possible. The index finger of the respondent served as an indicator for the investigator to know the start and end of the recording time. The thumb and the centre finger were used to hold the nose to avoid letting the air through nostrils. The subjects were requested not to let the air out by opening the mouth while recording the Breath Holding Time. The time of holding the breath till the subject let the air out was clocked by using the stop watch to the nearest one tenth of a second and this is taken as this score. (Astrand and Rodahl,1977)

Vital Capacity:-

Purpose:

To measure the Vital Capacity of the subjects

Equipment:

The apparatus Wet Spirometer was used to measure the Vital Capacity.

Procedure:

The subject sit at ease and inhale as much as air one can and exhale this air into the mouth piece of the Spirometer, which indicate the Vital Capacity in litres. Care must be taken while blowing so as not to leak any amount of air between the mouth piece of the Spirometer and mouth. (Rayner, 1977)

Blood pressure:-

Purpose:

To assess the Systolic Pressure and Diastolic Pressure of the subjects.

Equipment:

Sphygmomanometer , stethoscope, scoring sheet and a pencil

Procedure:

The subject was asked to sit comfortably on a chair, with the left arm slightly flexed and whole forearm supported at the heart level on the table. The subject was asked to have the weight of the body on the forearm with the fingers relaxed. The center of the rubber compressor bag was squarely placed over the brachial artery and then the silk cuff was wrapped in such a manner that the end of bandage were tucked in nearly avoiding any racks in wrapping. Later, the systolic and diastolic points were determined from the different sounds made by blood in the artery, as the artery is subjected to various degrees of compression. The sounds were heard by means of stethoscope applied just below the arm band at the bifurcation of the brachial artery.

Scoring:

Systolic pressure : Pressure was applied by means of the pressure balls and with the left hand palpating the pulse, the pressure was continued for about a further of 10 mm above the point of pulse disappearance. The stethoscope was applied to the brachial artery together by releasing the pressure in the rubber compressor bag slowly and evenly by means of a slight movement of the release screw of the control valve, care was taken to listen for heart sounds. The first sound was usually clear and easy to distinguish, the first regular beat being heard should be read as the point of systolic pressure**.**

Diastolic Pressure: The process was continued to release the pressure and tone and volume of the sound changed and finally disappeared in a faint murmur. The last sound just before disappearance was the point to read the diastolic pressure**.** (Johnson and Nelson, 1986)

Cooper's Twelve Minutes Run/Walk Test:-

Purpose:

The purpose of this test was to assess the Cardio-Respiratory Endurance of the subjects.

Facilities and equipment:

The test was administered on a 400 M track. A stop watch with calibration of 1/100 of a second, a whistle, score sheet and pencils were used to administer the test.

Procedure:

Cooper's twelve minutes run/ walk rest was administered with the help of qualified testers. For this test, a 400M track was prepared with marking at every tenth metre. The investigator and the testers served as the lap scorers. The subjects were asked to stand on the starting line drawn at finish line of the 400M track and were given instructions to cover as much distance as possible by running/walking. They were instructed to continue running /walking till the final whistle. The race was started with a whistle and the number of minutes left was announced to the subjects every minute and at the twelfth minutes a whistle was blown a second time and the subjects stopped instantly and stood on the spot. The distance covered by each subject in twelve minutes was recorded to the nearest tenth of a metre.

The distance covered by the subjects was used as a measure of Cardio-Respiratory Endurance (Johnson and Nelson, 1986)

STATISTICAL TECHNIQUES

The data collected from the three groups before and after the treatment were statistically examined for significant difference in means by applying analysis of co-variance (ANCOVA). Later, wherever the F- ratio was found

to be significant, the Scheffe's post-hoc test was applied so as to test whether actual differences existed among the adjusted post-hoc means. The level of significance was set at 0.05.

The data was analyzed on the computer using the statistical package for social sciences (SPSS) and the level of significance was fixed at 0.05.

CHAPTER- IV

ANALYSIS OF THE DATA AND RESULT OF THE STUDY

ANALYSIS OF THE DATA

The analysis of the data pertaining to the study is presented in this chapter. The study was designed to test the effect of Ayurvedic-Herbal Medicine "*Lakshadi Choornam*"(powder) with ingredients 'Lassifer lacca' and 'Mymosapudica' on Cardio-Respiratory Endurance. Different biochemical variables such as Hemoglobin, Blood Sugar, Total Cholesterol and Physiological variables such as Resting Pulse Rate, Respiratory Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Respiratory Rate, Breath Holding Time and the Physical fitness variable Cardio- Respiratory Endurance were statistically analysed.

Analysis of co-variance was used to test the mean differences among the three groups. Later, wherever the F- ratio was found to be significant, the Scheffe's post-hoc test was applied so as to test whether actual differences existed among the adjusted post-hoc means. The level of significance was set at 0.05.

FINDINGS

Table 4:1

Analysis of Co-variance done among the different groups on Hemoglobin

	Control	**Placebo**	**Exp-erimental**	***Source of Variance***	***Sum of Squares***	***df***	***Mean Squares***	**'F' Ratio**
Pre-test Mean	14.2667	14.2200	14.2467	Between	0.0164	2	0.0082	0.008
SD	0.72572	1.29240	0.90069	Within	42.115	42	1.003	
Post-test Mean	14.1333	14.7467	14.9600	Between	1.125	2	0.563	2.424
SD	0.89655	0.91952	1.33031	Within	47.867	42	1.140	
Adjusted Post-test Mean	14.125	14.756	14.959	Between	1.024	2	0.512	2.783
				Within	41.810	41	1.020	

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.230 and $df_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on hemoglobin do indicates, the F- ratio in the pre-test as 0.08 and in the post-test as 2.424, which were much less than the tabulated $F_{(2, 42)}$ of 3.220. In the adjusted post test also F-ratio found was only 2.783, which was much less than the tabulated $F_{(2, 41)}$ of 3.230. Since, the F- ratio for adjusted post-test was found to be insignificant, the post- hoc test was not done.

Table 4:2

Analysis of Co-variance done among the different groups on Blood Sugar

	Control	**Placebo**	**Exp-erimental**	***Source of Variance***	***Sum of Squares***	***df***	***Mean Squares***	**'F' Ratio**
Pretest Mean	73.07	74.33	74.13	Between	13.911	2	6.956	0.070
SD	11.24	8.9176	9.613	Within	4176.00	42	99.429	
Posttest Mean	71.67	74.73	73.67	Between	72.711	2	36.356	0.493
SD	7.79	10.19	7.508	Within	3095.60	42	73.705	
Adjusted Posttest Mean	71.67	74.73	73.665	Between	72.04	2	36.022	0.477
				Within	3095.39	41	75.497	

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.230 and $df_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on Blood Sugar do indicates, the F-ratio in the pre-test as 0.070 and in the post-test as 0.493, which were much less than the tabulated $F_{(2, 42)}$ of 3.220. While in the adjusted post-test it was only 0.477, which was also much less than the tabulated $F_{(2,41)}$ of 3.230. Since the F-ratio for adjusted post-test was found to be insignificant, the post-hoc test was not done.

Table 4:3

Analysis of Co-variance done among the different groups on Total Cholesterol

	Control	**Placebo**	**Exp-erimental**	***Source of Variance***	***Sum of Squares***	***df***	***Mean Squares***	**'F' Ratio**
Pretest Mean	214.26	184.53	220.5333	Between	11096.71	2	5548.3	4.095 *
SD	31.653	24.115	49.8166	Within	56912.400	42	1355.0	
Posttest Mean	169.40	162.00	166.6667	Between	420.044	2	210.02	0.297
SD	30.965	23.862	24.2919	Within	29656.933	42	706.11	
Adjusted Posttest Mean	165.51	172.88	159.668	Between	1119.306	2	559.65	1.470
				Within	15611.377	41	380.76	

* Significant at 0.05 level.

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.230 and $df_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on Total Cholesterol do indicates, the F-ratio in the pre- test as 4.095 and in the post-test as 0.297. The F-ratio in the Pre -test mean is found to be significant, while F- ratio for the post-test mean is much less than the tabulated $F_{(2, 42)}$ of 3.220. And for the adjusted post- test it was only 1.470, which was much less than the tabulated $F_{(2, 41)}$ of 3.230. Since the F- ratio for adjusted post- test was found to be insignificant, the post hoc- test was not done.

Table 4:4
Analysis of Co-variance done among the different groups on Systolic Blood Pressure

	Control	Placebo	Exp-erimental	*Source of Variance*	*Sum of Squares*	*df*	*Mean Squares*	'F' Ratio
Pretest Mean	121.66	118.00	114.6667	Between	367.778	2	183.889	1.332
SD	11.751	13.9898	8.9576	Within	5796.667	42	138.016	
Posttest Mean	118.06	121.000	112.0000	Between	632.044	2	316.022	2.406
SD	9.6988	15.7208	7.2703	Within	5516.933	42	131.356	
Adjusted Posttest Mean	116.08	121.062	113.918	Between	400.685	2	200.343	2.209
				Within	3718.980	41	90.707	

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.230 and $df_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on Systolic Blood Pressure do indicates, the F-ratio in the pre -test as 1.332 and in the post-test as 2.406, which were much less than the tabulated $F_{(2, 42)}$ of 3.220. In the Adjusted post- test, it was only 2.209, which was much less than the tabulated $F_{(2,41)}$ of 3.230. Since the F-ratio for adjusted post-test was found to be insignificant, the post-hoc test was not done.

Table 4:5
Analysis of Co-variance done among the different groups on Diastolic Blood Pressure

	Control	**Placebo**	**Exp-erimental**	***Source of Variance***	***Sum of Squares***	***df***	***Mean Squares***	**'F' Ratio**
Pretest Mean	79.6667	75.3333	74.6667	Between	221.111	2	110.556	1.039
SD	9.3478	11.0948	10.4312	Within	4470.000	42	106.429	
Posttest Mean	76.5333	78.0000	73.3333	Between	170.844	2	85.422	0.997
SD	8.7576	12.0712	5.8757	Within	3597.067	42	85.644	
Adjusted Posttest Mean	74.912	78.637	74.318	Between	163.853	2	81.927	1.409
				Within	2383.243	41	58.128	

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.230 and $df_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on Diastolic Blood Pressure do indicates, the F-ratio in the pre-test as 1.039 and in the post-test as 0.997, which were much less than the tabulated $F_{(2, 42)}$ of 3.220. In the adjusted post-test, the F-ratio was only 1.409, which was much less than the tabulated $F_{(2, 41)}$ of 3.230. Since, the F-ratio for adjusted post-test was found to be insignificant, the post-hoc test was not done.

Table 4:6

Analysis of Co-variance done among the different groups on Vital Capacity

	Control	Placebo	Exp-erimental	*Source of Variance*	*Sum of Squares*	*df*	*Mean Squares*	'F' Ratio
Pretest Mean	3700.00	3766.67	3616.67	Between	169444.44	2	84722.22	2.284
SD	560.61	546.63	673.92	Within	14941666.	42	355753.9	
Posttest Mean	3573.33	3650.00	3740.00	Between	208777.78	2	104388.8	0.477
SD	353.99	507.09	524.13	Within	9200333.3	42	219055.5	
Adjusted Posttest Mean	3570.08	3607.77	3785.46	Between	393994.56	2	196997.2	1.973
				Within	4093792.9	41	99848.61	

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.230 and $df_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on Vital Capacity do indicates, the F- ratio for the pre-test as 2.284 and for the post-test as 0.477, which were much less than the tabulated $F_{(2, 42)}$ of 3.220. While, the adjusted post test was only 1.973, which was also much less than the tabulated $F_{(2,41)}$ of 3.230. Since the F-ratio for adjusted post-test was found to be insignificant, the post hoc-test was not done.

Table 4:7

Analysis of Co-variance done among the different groups on Resting Pulse Rate

	Contro	Placeb	Exp-	*Source*	*Sum of*			

	l	o	erimental	*of Variance*	*Squares*	*df*	*Mean Squares*	'F' Ratio
Pretest Mean	55.7333	56.4667	56.000	Between	4.133	2	2.067	0.033
SD	6.7662	10.5144	5.5162	Within	2614.667	42	62.254	
Posttest Mean	53.8667	54.8667	55.6667	Between	24.400	2	12.200	0.326
SD	6.3117	6.8229	5.0943	Within	1572.800	42	37.448	
Adjusted Posttest Mean	54.009	54.696	55.695	Between	21.567	2	10.783	0.403
				Within	1096.978	41	26.756	

The table value required for significance at 0.05 level of confidence with df $_{(2,41)}$) is 3.230 and df $_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on Resting Pulse Rate do indicates, the F-ratio for the pre-test as 0.033 and for the post-test as 0.326, which were much less than the tabulated $F_{(2,42)}$ of 3.220. While, the adjusted post- test F-ratio was only 0.403, which was also much less than the tabulated $F_{(2, 41)}$ of 3.230. Since, the F-ratio for adjusted post-test was found to be insignificant, the post-hoc test was not done.

Table 4:8

Analysis of Co-variance done among the different groups on Respiratory Rate

	Control	**Placebo**	**Supple-mentation**	***Source of Variance***	***Sum of Squares***	***df***	***Mean Squares***	**'F' Ratio**
Pretest Mean	15.8667	16.4667	16.5333	Between	4.044	2	2.022	0.163
SD	3.94365	3.02056	3.54293	Within	521.200	42	12.410	
Posttest Mean	17.0000	16.6889	16.3333	Between	3.378	2	1.689	0.188
SD	2.75162	3.01109	3.22195	Within	378.267	42	9.006	
Adjusted Posttest Mean	17.327	16.595	16.144	Between	10.629	2	5.315	3.363*
				Within	64.802	41	1.581	

*Significant at 0.05 level

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.230 and $df_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on Respiratory Rate do indicates, the F- ratio for the pre-test as 0.163 and for the post-test as 0.188, which were much less than the tabulated $F_{(2, 42)}$ of 3.220. But on the other hand, the adjusted post-test F-ratio was 3.363, which was much higher than the tabulated $F_{(2, 41)}$ of 3.230. Since ,the F-ratio in the adjusted post-test was found to be significant, the post-hoc test was applied to find out whether there existed actual differences among the paired means.

Table 4:9

Scheffe's Post-hoc Test done on the three groups for differences between adjusted Post-test paired means on Respiratory Rate

Adjusted Post -test Mean			Mean Differences	Critical Difference
Control Group	Placebo Group	Supplementation Group		
17.327		16.144	1.183*	1.167
17.327	16.595		0.732	1.167
	16.595	16.144	0.451	1.167

*Significant at .05 level.

The above table do indicate that, there exist significant mean difference between the supplementation group and the control group, as the mean difference of 1.183 was much above the critical difference of 1.167. On the other hand, no significant mean differences were found between the placebo group and supplementation group and between the control group and placebo group, as the mean differences were only 0.451 and 0.732 respectively, which were much less than the critical difference of 1.167.

Figure 4:1

Graphical representation of the Pre -test, Post-test and adjusted Post-test means on Respiratory Rate of the three different groups

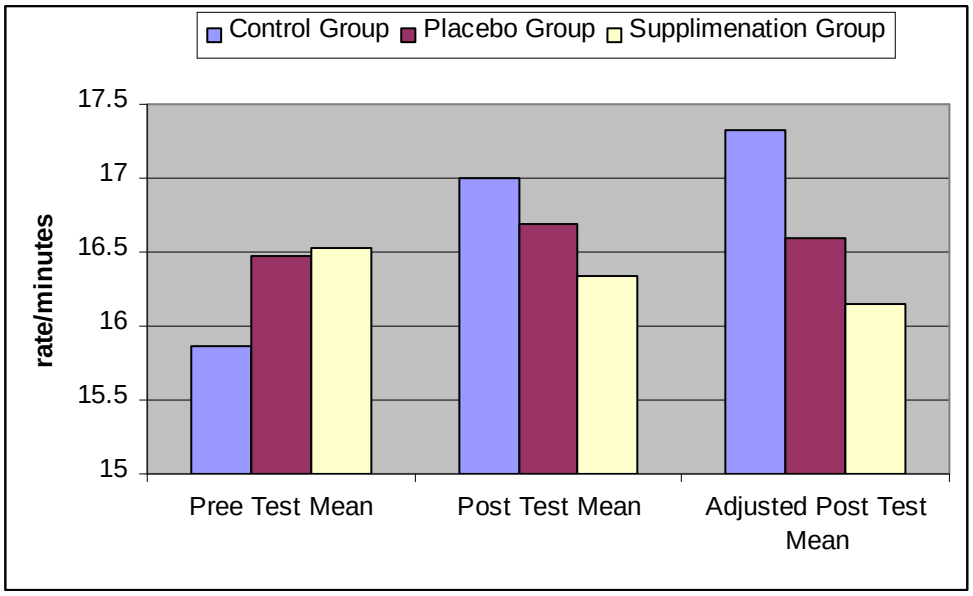

Table 4:10

Analysis of Co-variance done among the different groups on Breath Holding Time

	Control	Placebo	Supple-mentation	*Source of Variance*	*Sum of Squares*	*df*	*Mean Squares*	'F' Ratio
Pretest Mean	63.6667	60.4667	60.8000	Between	92.844	2	46.422	0.404
SD	11.48705	9.38743	11.14963	Within	4821.467	42	114.797	
Posttest Mean	66.0667	65.1333	72.2667	Between	450.978	2	225.489	1.934
SD	11.55401	8.11407	12.26183	Within	4895.600	42	116.562	
Adjusted Posttest Mean	64.387	66.111	72.968	Between	614.129	2	307.065	8.018*
				Within	1570.135	41	38.296	

* Significant at 0.05 level.

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.230 and $df_{(2,42)}$ is 3.220

The above table related to the analysis of co-variance done among the different groups on Respiratory Rate do indicates, the F- ratio for the pre-test as 0.404 and for the post-test as 1.934, which were much less than the tabulated $F_{(2, 42)}$ of 3.220. On the other hand, the adjusted post-test F-ratio was found to be 8.018, which was much higher than the tabulated $F_{(2, 41)}$ of 3.230. Since the F-ratio in the adjusted post-test was found to be significant, the post- hoc test was applied to find out whether there existed actual differences among the paired means.

Table 4:11

Scheffe's Post-hoc test done on the three groups for differences among adjusted Post-test paired means on Breath Holding Time

Adjusted Post-test Mean			Mean Differences	Critical Difference
Control Group	Placebo group	Supplementation Group		
64.387		72.968	8.581*	5.743
64.387	66.111		1.724	5.743
	66.111	72.968	6.857*	5.743

*Significant at .05 level.

The above table do indicate that there exist significant mean differences between the supplementation group and control group and the supplementation group and the placebo group, as the mean differences of 8.581 and 6.857 respectively were much above the critical difference of 5.743. On the other hand, no significant mean difference was found between the placebo group and control group, as the mean difference was only 1.724, which was much less than the critical difference of 5.743.

Figure 4:2

Graphical representation of the Pre-test, Post-test and adjusted Post-test means on Breath Holding Time of the three Different Groups

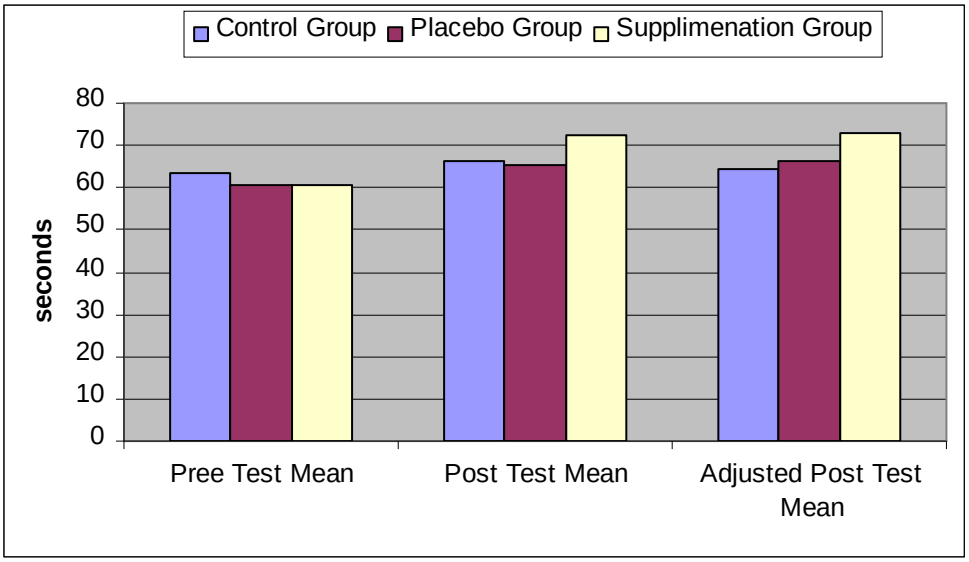

Table 4:12

Analysis of Co-variance done among the different groups on Cardio-Respiratory Endurance

	A	B	C	*Source of Variance*	*Sum of Squares*	*df*	*Mean Squares*	'F' Ratio
Pretest Mean	2678.33	2664.67	2591.33	Between	65667.778	2	32833.889	.811
SD	187.9748	211.5881	203.2633	Within	1699880.000	42	40473.333	
Posttest Mean	2739.00	2794.33	2745.00	Between	27657.778	2	13828.889	.176
SD	257.6695	372.3999	173.7917	Within	3293903.333	42	78426.270	
Adjusted Posttest Mean	2713.70	2779.34	2785.29	Between	46534.843	2	23267.421	.410
				Within	2327702.227	41	56773.225	

The table value required for significance at 0.05 level of confidence with $df_{(2,41)}$ is 3.23 and $df_{(2,42)}$ is 3.22

The above table related to the analysis of co-variance done among the different groups on Cardio respiratory do indicates, the F- ratio in the pre-test as 0.811 and in the post- test as 0.176, which were much less than the tabulated $F_{(2, 42)}$ of 3.220. While in the adjusted post test, it was only 0.410 which was also much less than the tabulated $F_{(2, 41)}$ of 3.230. Since, the F-ratio for adjusted post-test was found to be insignificant, the post-hoc test was not done.

DISCUSSION OF FINDINGS AND HYPOTHESIS

The purpose of the study was to test the effect of selected Ayurvedic-herbal medicine on the performance of Cardio-Respiratory Endurance. For this purpose, the researcher selected ayurvedic- herbal medicins known as '*Lakshadi Choornam'* (powder) with 'Laccifer Lacca' and 'Mymosa Pudicca' as ingredients.

The result on Hemoglobin analysis indicates that, there exists no significant difference among the three groups . This do indicates that Lassifer Lacca and Mymosa Pudicca have no influence on Hemoglobin, thereby accepting the hypothesis thus formulated. This might be due to the fact that, the *Lakshadi Choornam* with Lassifer Lacca and Mimosa Pudicca as ingredients, do have a link with the purification of blood, coagulation of blood etc. and on the other hand, there are no clear remarks about the increase of erythrocytes in blood. Further, in *Laksahdi Choornam* only Lassifer lacca is having these properties and not at all found in Mimosa Pudicca.

The result on Blood Sugar analysis indicates that, there exists no significant difference among the three groups. This do indicates that, Lassifer Lacca and Mymosa Pudicca have no influence on Blood Sugar, thereby accepting the hypothesis thus formulated. This might be due to the fact that, Blood Sugar in Ayurveda is known us *Prameha* and it is a condition due to the vitiation of *Thridosa* predominantly *Kapha* affecting blood and *medas* etc. In Ayurveda, patients with Blood Sugar are normally treated with medicines with properties like bitter, astringent etc., this might be due to the fact that,

although, Lassifer Lacca or Mimosa Pudicca are the type of herbal medicines which can be given to sugar patients to reduce Blood Sugar, some at times some medicines do act like that, even if they show the same properties they may not be acting in the same way on all the patients and another cause might be due to the reason that, the subjects in this study have only less chance to have more sugar in their blood as they were doing moderate physical activity during the period of experiment and their age ranged from 18-25 years.

The result on Total Cholesterol analysis indicates that there exists no significant difference among the three groups. This do indicates that, Lassifer Lacca and Mymosa Pudicca do not have any influence on Total Cholesterol, thereby accepting the hypothesis thus formulated. This might be due to the fact that, as in the case of Blood Sugar the Lassifer Lacca and Mimosa Pudicca are types of herbal medicines which can be given to patients with more Cholesterol in their blood, but administration of this herbal-medicines have not shown any significant difference in Total Cholesterol as normally the age and the Physical qualities of the subjects might have to be considered when, such herbal medicines are to be administered.

The result on Resting Pulse Rate and Vital Capacity analysis do indicates that, there exists no significant difference among the three groups. This do indicates, that, Lassifer Lacca and Mymosa Pudicca do not have any influence on Resting Pulse Rate and Vital Capacity thereby accepting the hypothesis thus formulated. In Ayurveda, *Laksadi Choornam* can be given

to enhance the performance of thoracic region, but there was no significant change in the Resting Pulse Rate and Vital Capacity, as the reason might be that the dose and the duration of supplementation of the medicine may not be sufficient because, normally the duration and the dosage of the supplementation are according to the degree of the illness. On the other hand, in this study the supplementation is given to normal individuals with good physical qualities and another reason might be that for a significant change in the results, the duration and dosage of supplementation may not be sufficient for normal individuals.

The results on Systolic Blood Pressure and Diastolic Blood Pressure analysis do indicates that, there exists no significant difference among the three groups. This does means that Lassifer Lacca and Mymosa Pudicca have no influence the Systolic Blood Pressure and Diastolic Blood pressure of the subjects thereby accepting the hypothesis thus formulated.

The results on Respiratory Rate and Breath Holding Time do indicates that, there exists significant differences among the three groups. In case of Respiratory Rate, no significant difference was found between the control group and placebo group and between the supplementation group and placebo group, while there was significant difference between the control group and the supplementation group, thereby, rejecting the hypothesis formulated. While in case of Breath Holding Time, no significant differences were found between the control group and the placebo group. But, significant differences were found between the control group and the Supplementation group and

between the supplementation group and the placebo group, thereby, rejecting the hypothesis formulated. This significant difference found might be due to the fact that in *Lakshiadi Choornam*, Mimosa Pudica is such a medicine which is normally used to be given to patients with asthma, breathlessness and fatigue. Here, the herbal medicine is administered on the subjects who have normal health and because of these medicinal properties, they might have developed better Breath Holding Time and Respiratory Rate.

The final aim of the study was to find out whether *Lakshadi Choornam* (powder) do have any effect on the Cardio-Respiratory Endurance of the subjects. The result on Cardio-Respiratory Endurance do indicates that, no significant differences existed among three groups. It means that Lassifer Lacca and Mymosa Pudicca may not have any influence on the Cardio Respiratory- Endurance of the subjects thereby accepting the hypothesis thus formulated.

The *Lakshadi Choornam* (powder) as per the reference of Ayurvedic literature is a type of Medicine which is coming under '*Balya*' or '*Bala*' which do mean performance enhancing. In Ayurveda *bala* is known us '*Vyayam Shakthi'* and athletic performance do come under '*Vyayam Shakthi*'. Thus, the biochemical variables like Hemoglobin, Blood Sugar, Total Cholesterol may not be directly influenced by the herbal medicines for *Vyam shakthi*. While Physiological variables like Respiratory Rate and Breath Holding Time have shown significant changes after the administration of the herbal medicines. Even if there are some significant changes in some of the

Physiological variables, it may not be sufficient to produce a significant change in the Cardio-Respiratory Endurance and hence, it need to be concluded that, the administration of *Lakshad*i *Choornam* (Powder) have no effect on Cardio-Respiratory Endurance.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

SUMMARY

Health is an important part of one's successful life or in other words, to lead a happy life, health has a great role and it includes physical, mental, social and emotional health of man. Among these, the physical health is important and depends upon the good functioning of different systems in the human body. Success in sports depends primarily on genetic endowment in athletes with morphological, psychological, physiological and metabolic traits specific to performance characteristics vital to their sport. Such genetically-endowed athletes must also receive optimal training to increase physical power, enhance mental strength and provide a mechanical advantage. When humans compete one another either in war or in sports the competitors, by definition, seek to achieve an advantage over opponent. Frequently, they use drugs and other performance enhancing substances to gain the upper hand. However, athletes often attempt to go beyond training and use substances and techniques. The functioning of different systems is related to the food that is consumed and inorder to preserve the health from different diseases and to enhance or to promote the positive health, different systems of medicines are used and of these, the Ayurvedic system of medicine is a conventional form of medicine widely used in India. In Ayurveda, as well as the ancient

Egyptians, Roman and Chinese found the significance of many herbal-medicines for the betterment of physical performance. Herbal plants and spices are the important ingredients in Ayurvedic medicines and these plants and spices have magical powers not only to cure diseases but also to develop positive health so as to improve physical fitness. Among the Ayurvedic-Herbal medicines, Mimosa Pudicca and Laccifer Lacca are important medicines which helps to preserve positive health and from early times till today the above medicines has been used in various forms for healing diseases as well as for building strength and endurance.

The purpose of this study was to test the effect of consumption of "*Lakshadi Choornam*" (powder) with ingredients Lassifer Lacca and Mimosa Pudicca on performance of Cardio- Respiratory Endurance of the subjects. To achieve the purpose of the study, the research scholar has selected 45 college men students who were undergoing professional course in Physical Education as subjects. They have been selected randomly and assigned to three equal groups. Group one was control group, group two was placebo group and group three was the experimental group. The group two was given only normal wheat powder as a placebo and the control group do not consume anything. The experimental group consumed one gram of the prepared herbal medicines as daily dose three times a day for forty five days i.e. after breakfast, after lunch and after supper. There was no change in the daily routine of any of the subjects of the three selected groups during the period of experimentation. Pre-tests were conducted 24 hrs. before the beginning of the

experimentation and post-tests were conducted 24 hrs. after the completion of the experiment for all the three groups. Apart from Cardio-Vascular Endurance, selected biochemical variables namely Hemoglobin, Total Cholesterol, Blood Sugar and selected physiological variables namely Resting Pulse Rate, Vital Capacity, Respiratory Rate, Breath Holding Time, Systolic Blood Pressure, Diastolic Blood Pressure were also tested.

The data collected from all the three groups were statistically examined for significant difference if any, by applying the analysis of co-variance. After eliminating the influence of pre-test means, the adjusted post test means of the three groups were tested for significance and if there were any significant difference, the Scheffe's Post-hoc test were applied to find out the significant difference between paired means.

CONCLUSIONS

From the results of the study the following conclusions were drawn.

1. The result of the study indicates that there was no significant difference on Hemoglobin among the control group and the other two experimental groups since, there was no effect on Hemoglobin of the subjects by the consumption of *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca.

2. There was no significant difference between the three groups on Total Cholesterol. This indicates that, *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca does not have any effect so as to reduce the Total Cholesterol.

3. No significant difference was noticed among the three groups on Blood Sugar. This indicates that, *Lakshadi Chooornam* with ingredients Lassiffer Lacca and Mymosa Pudicca does not have any effect neither to increase nor to decrease Blood Sugar.

4. The result of the study indicates that, there was no significant difference on Resting Pulse Rate among the control group and the other two experimental groups since, there was no effect on Resting Pulse Rate by the consumption of *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca.

5. The result of the study indicates that, there was no significant difference on Vital Capacity among the control group and the other

two experimental groups, as there was no effect on Vital Capacity by the consumption of *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca.

6. The result of the study indicates that, there was no significant difference on Systolic and Diastolic Blood Pressure among the control group and the other two experimental groups since, there was no effect on Blood Pressure by the consumption of *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca.

7. There was significant difference on Respiratory Rate between the control group and the supplementation group, as there was significant differences among the adjusted post–test means of the two groups on Respiratory Rate by the consumption of *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca.

8. The result of the study indicates that there was significant difference on Breath Holding Time between the control group and supplementation groups and the placebo group and the supplementation group, as there were significant differences among the adjusted post-test means of the different said group on Breath Holding Time by the consumption of *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca.

9. There was no significant difference on Cardio-Respiratory Endurance among the control group and the other two experimental

groups, as there was no effect on Cardio-Respiratory Endurance of the subjects by the consumption of *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca.

10. In Ayurveda, athletic performance is coming under *Balya* or *Bala* which means *Vyayam Sakthi*. The selected medicine *Lakshadi Choornam* with ingredients Lassifer Lacca and Mymosa Pudicca is a type of medicine which can be given to increase the *Vyayam Shakthi* or athletic performance. It can be concluded that, even if the biochemical variables selected like Hemoglobin, Total Cholesterol and Blood Glucose do have a direct relationship with Endurance performance, they were not influenced by the supplementation. While, the physiological variables Resting Pulse Rate, Breath Holding time, Blood Pressure and Vital Capacity which do have direct relationship with Cardio- Respiratory Endurance performance have not shown any significant changes. On the other hand Breathe Holding Time and Respiratory Rate have shown some significant changes after the supplementation. Even though, some of the physiological variables have shown some significant change after supplementation, it may not be sufficient to produce a significant changes on the Cardio-Respiratory Endurance of the subjects after supplementation of the Ayurvedic-herbal medicines *Lakshadi Choornam*.

RECOMMENDATIONS

On the basis of the results of the study and conclusions drawn the following recommendations are made**.**

1. It is recommended that the '*Lakshadi Choornam'* with ingredients Lassiffer Lacca and Mymosa Pudicca can be given to sports persons who suffer from asthma or bronchial disorders.

2. *Lakshadi Choornam* with ingredients Lassiffer Lacca and Mymosa Pudicca can be given to sports persons who are suffering from breathlessness while doing physical activities.

3. It is recommended that, coaches and Physical Education teachers should employ the advantage of Ayurvedic- Herbal Medicine for the improvement of performance.

4. It is recommended that, further studies may be conducted by increasing the dosage of *Lakshadi Choornam* on the subjects.

5. It is recommended that, further studies may be conducted by increasing the duration of the treatment.

6. Further studies may be conducted by adding more herbal medicines with *Lakshadi Choornam.*

7. The same study may be conducted on long distance runners by increasing the dosage and duration of the treatment.

8. The same study can be conducted among female athletes on the selected variables.

9. Similar studies can be conducted to find out the effect of *Lakshadi Choornam* on other Physiological, Biochemical and Physical Fitness variables.

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APPENDIX –A

Raw score on Hemoglobin of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
14.1	14.4	13.7	15.6	15.3	15.5
15.3	14.5	14.1	15.5	12.9	14.2
12.7	13.1	14.7	15.9	14.4	15.2
14.2	12.9	14.2	14.9	15.0	15.7
14.6	14.4	15.6	15.4	13.0	14.5
13.5	15.3	15.6	13.9	14.6	16.1
14.5	15.2	10.5	14.5	15.0	15.4
15.0	14.0	15.0	13.6	14.8	15.6
15.1	13.6	13.7	14.8	13.4	12.9
14.1	14.7	14.9	16.2	15.1	17.1
14.5	15.7	15.4	15.5	14.7	17.2
13.8	14.2	14.4	14.5	13.7	14.5
14.8	13.9	12.7	14.0	15.3	13.9
13.2	12.6	14.6	13.5	13.6	13.8
14.6	13.5	14.2	13.4	12.9	12.8

APPENDIX –B

Raw score on Blood Sugar of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
60	74	87	91	78	78
89	87	62	64	72	79
62	76	73	69	68	85
64	72	84	83	65	68
74	78	72	77	71	69
72	69	73	84	69	73
60	71	67	68	74	78
72	60	60	93	82	82
71	79	79	80	77	78
74	79	72	77	84	84
82	69	62	72	65	69
78	75	88	62	62	62
100	61	82	63	66	67
62	63	77	76	80	71
76	62	77	62	99	62

APPENDIX-C

Raw score on Total Cholesterol of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
220	173	213	169	239	199
203	145	158	138	200	168
150	137	189	160	222	155
247	237	220	220	270	179
210	136	185	135	218	156
249	174	148	137	220	186
174	132	154	158	205	165
209	171	190	180	188	150
194	174	200	144	175	145
190	169	204	162	361	200
237	187	155	140	224	145
278	231	217	178	205	158
221	148	164	155	253	215
207	165	192	196	145	129
225	162	179	158	183	150

APPENDIX-D

Raw score on Resting Pulse Rate of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
54	60	86	65	55	50
45	42	49	46	52	49
70	54	46	49	61	53
53	55	51	55	64	63
63	57	59	50	46	56
52	51	40	47	54	48
50	49	62	60	52	55
55	46	59	60	53	59
58	52	52	49	58	59
60	54	60	62	61	61
58	63	60	54	47	49
66	55	54	49	60	62
51	48	53	50	62	60
50	66	65	65	54	53
51	56	51	62	61	58

APPENDIX-E

Raw score on Systolic Blood Pressure of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
130	115	155	170	120	105
125	115	120	130	110	100
115	130	110	115	110	110
110	118	110	110	110	120
135	130	120	120	100	125
140	110	100	100	110	120
130	120	115	120	105	110
130	125	110	120	130	110
110	110	110	130	110	105
120	115	110	115	120	120
110	110	110	110	130	120
130	120	125	120	110	110
130	140	125	120	125	105
100	105	140	125	110	110
110	108	110	110	120	110

APPENDIX-F

Raw score on Diastolic Blood Pressure of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
85	70	110	110	70	75
85	80	80	90	65	65
80	90	80	75	70	70
70	78	70	70	70	70
90	85	70	70	65	85
85	70	65	60	70	80
100	80	65	70	60	70
80	75	70	80	100	80
65	65	80	80	75	70
80	75	75	85	75	75
70	70	65	70	90	80
85	80	75	90	80	75
80	95	75	70	85	65
70	65	80	75	70	70
70	70	70	75	75	70

APPENDIX-G

Raw score on Vital Capacity of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
3500	3750	3500	3500	4500	5000
3250	3000	4250	4000	3500	3750
2750	3350	4500	4250	4000	4250
3750	4000	3750	3250	3000	3500
3000	3250	4000	3500	4000	3750
4250	3750	3750	3750	3000	3250
4250	3500	3500	4000	2750	3350
4250	3500	3750	3500	3500	3500
3500	3500	5250	5000	3500	3500
3500	3000	3500	3000	4750	3500
4000	3750	3250	3250	2750	3500
4500	4000	3500	3750	3000	3250
3250	3500	3250	3250	3500	3500
3250	3500	3500	3500	3750	3750
4500	4250	3250	3250	4750	4750

APPENDIX-H

Raw score on Respiratory Rate of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
12	13	18	17	12	11
23	21	11	14	19	20
12	14	11	13	18	20
15	13	12	15	15	17
17	18	19	21	20	19
17	17	16	16	19	20
14	13	20	19	20	19
17	18	21	20	19	19
20	19	13	15	14	16
18	17	17	19	13	14
17	19	20	21	17	17
23	21	14	16	14	13
17	18	12	15	15	16
12	11	12	14	20	18
14	13	22	20	12	12

APPENDIX-I

Raw score on Breath Holding Time of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
52	50	54	68	71	80
55	60	62	68	72	69
53	50	61	67	72	60
72	79	46	50	61	68
47	56	63	70	54	68
52	64	68	80	57	60
80	82	62	81	52	61
54	60	48	61	59	67
72	70	53	58	67	64
73	75	57	72	64	64
62	51	62	73	45	54
82	81	65	71	45	50
62	64	50	65	53	63
62	69	92	98	72	69
77	80	69	90	63	80

APPENDIX-J

Raw score on Cardio-Respiratory Endurance of control, placebo and experimental groups

Control group		Placebo group		Experimental Group	
Pre Test	**Post Test**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
2625	2700	2620	1730	2700	2900
2640	2700	2480	2850	2835	2400
2630	2710	2710	2750	2680	2750
3170	3390	2390	2700	2700	2840
2550	2630	2830	3000	2770	2830
2580	2800	2710	2930	2665	2800
2940	3110	2700	3040	2720	2935
2850	2735	2600	2700	2470	2640
2650	2710	2820	3300	2200	2600
2750	2600	2530	2550	2600	2900
2680	2630	2750	2900	2920	2800
2430	2200	3240	3310	2350	2680
2530	2600	2450	2900	2350	2400
2650	2820	2440	2575	2500	2950
2500	2750	2700	2680	2410	2750

Figure 4:1

Graphical representation of the Pre -test, Post-test and Adjusted Post-test means on Respiratory Rate of the three different groups