As a society we are increasingly concerned about our physical appearance. For example, as much as 24% of people in developed countries admittedly exercise to improve their performance. Professional sportsmen and amateurs alike are in a constant search for new means that will enable them better sport results in shorter time. Among those means, a prominent place belongs to dietary supplements. However, the producers often advertise products whose use in sports is neither scientifically founded nor safe. This brings on an irrational use of herbal supplements which sometimes leads to unwanted side effects, but is more often of little use Koncic MZ et al. (2013). Plants provide us with most nutrients essential for life. Other than essential nutrients, plant foods contain naturally occurring substances, referred to 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. Herbs have been used as medicine throughout history.

Sprouted in the pristine land of India some 5000 years ago, Ayurveda, the science of life and longevity, is the oldest healthcare system in the world and it combines the profound thoughts of medicine and philosophy. Since then Ayurveda has stood for the wholesome physical, mental and spiritual growth of humanity around the worldAshvagandha in Sanskrit means "smelling like a horse ", probably originating from the odor of its fresh root which resembles that of a sweaty horse. Ashwagandha is biologically known as Withania Somnifera (WS). The species' name Somnifera means "sleep-bearing" in Latin, indicating that Ashvagandha was considered a sedative. Ashwagandha is commonly known as “Indian Winter cherry” or “Indian Ginseng”. It is also known as Indian winter cherry - is a shrub cultivated in India and North
America whose roots have been used for thousands of years by Ayurvedic practitioners Bhandari C R (1970).

Ashwagandha is one of the most important herb of Ayurveda used for millennia as a Rasayana for its wide ranging health benefits. The drugs and therapies explained as rasayana provide research opportunities for biology of regeneration. Rasayana is described as an herbal or metallic preparation that promotes a youthful state of physical and mental health and expands happiness Mishra at el. (2000). These types of remedies are given to small children as tonics, and are also taken by the middle-aged and elderly to increase longevity. Among the ayurvedic Rasayana herbs, Ashwagandha holds the most prominent place. It is known as “Sattvic Kapha Rasayana” Herb (Changhadi, 1938). Most of the Rasayana herbs are adaptogen / anti-stress agents. Ashwagandha is commonly available as a churna, a fine sieved powder that can be mixed with water, ghee (clarified butter) or honey.

The solanaceae family is comprised of 84 genera that include about 3,000 species, scattered throughout the world. Members of this family are generally annual shrubs. The genera Withania and Physalis play an important role in the indigenous medicine of South East Asia, e.g. in the Unani and Ayurvedic systems. The twenty-three known Withania species are widely distributed in the drier parts of tropical and subtropical zones, ranging from the Canary Islands, the Mediterranean region and northern Africa to Southwest Asia. Schonbeck T E (1972). Among them, only two species, W. somnifera and W. coagulans, are economically and medicinally significant, being used and cultivated in several regions.

In view of its varied therapeutic potential, it has also been the subject of considerable modern scientific attention. Ashwagandha roots are a constituent of over 200 formulations in Ayurvedha, Siddha and Unani medicine, which are used in the treatment of various physiological disorders Asthana R (1989). Withania appears in WHO monographs on Selected Medicinal Plants and an
American Herbal Pharmacopoeia monograph is also forthcoming Marderosion A D (2001).

Ashwagandha is also used as a general energy-enhancing tonic known as Medharasayana, which means ‘that which promotes learning and a good memory’ and in geriatric problems. The plant was traditionally used to promote youthful vigor, endurance, strength, and health, nurturing the time elements of the body and increasing the production of vital fluids, muscle fat, blood, lymph, semen and cells. The similarity between these restorative properties and those of ginseng roots has led to Ashwagandha roots being called Indian ginseng Singh S (1998). It also helps counteract chronic fatigue, weakness, dehydration, bone weakness, loose teeth, thirst, impotency, premature ageing, emaciation, debility, and muscle tension. The leaves of the plant are bitter in taste and used as an antihelmantic. The infusion is given in fever. Bruised leaves and fruits are locally applied to tumors and tubercular glands, carbuncles and ulcers Nadkarni KM (1976). The roots are used as a nutrient and health restorative in pregnant women and old people. The decoction of the root boiled with milk and ghee is recommended for curing sterility in women. The roots are also used in constipation, senile debility, rheumatism, general debility, nervous exhaustion, loss of memory, loss of muscular energy and spermatorrhoea Watt G A (1972). Today W. somnifera is widely cultivated in the drier parts of India (more than 4,000 ha) i.e. Manasa, Neemuch and Jawad tehsils of the Mandsaur District of Madhya Pradesh, Punjab, Sind and Rajasthan Sharma R (2001).

Structure and Chemical constituents of Ashwagandha

The chemistry of Withania species has been extensively studied and several groups of chemical constituents such as steroidal lactones, alkaloids, flavonoids, tannin etc. have been identified, extracted, and isolated. At present, more than 12 alkaloids, 40 withanolides, and several sitoindosides (a withanolide containing a glucose molecule at carbon 27) have been isolated and reported from aerial parts, roots and berries of Withania species. The major biochemical constituents of ashwaganda root are steroidal alkaloids and
steroloidal lactones in a class of constituents called withanolides. The major chemical constituents of these plants, withanolides, are mainly localized in leaves, and their concentration usually ranges from 0.001 to 0.5% dry weight (DW). The withanolides are a group of naturally occurring C28- steroidal lactones built on an intact or rearranged ergostane framework, in which C-22 and C-26 are appropriately oxidized to form a six-membered lactone ring. The basic structure (shown below) is designated as the withanolide skeleton Tursunova R N (1977).

![Ashwagandha Plant with Roots](image1)

![Basic Chemical Structure Withanolide](image2)

**Pharmacological Activity of Ashwagandha**

Centuries of Ayurvedic medical experience using Withania somnifera have revealed it to have pharmacological value as an adaptogen, antibiotic, abortifacient, aphrodisiac, astringent, antiinflammatory, deobstruent, diuretic, narcotic, sedative, and tonic Kirson I (2009).

**Anti-stress**

A study conducted by the Institute of Basic Medical Sciences at Calcutta University examined the effects of Ashwagandha on chronic stress in rodents. For a period of 21 days, the animals received a mild electric shock to their feet. The resulting stress on the animals produced hyperglycemia, glucose intolerance, increase in plasma corticosterone levels, gastric ulcerations, male sexual dysfunction, cognitive deficits, immunosuppression and mental
depression Bhattacharya SK (2003). Researchers using Withania somnifera discovered the animals given the herb an hour before the foot shock experienced a significantly reduced level of stress. This research confirms the theory that Ashwagandha has a significant anti-stress adaptogenic effect Bhattacharya A (2001).

Research conducted at the Department of Pharmacology, University of Texas Health Science Center indicated that extracts of Ashwagandha produce GABA-like activity, which may account for the herb's anti-anxiety effects Mehta AK (1991). GABA (Gamma Amino-butyric acid) is an inhibitory neurotransmitter in the brain. Its function is to decrease neuron activity and inhibit nerve cells from over firing. This action produces a calming effect. Excessive neuronal activity can lead to restlessness and insomnia, but GABA inhibits the number of nerve cells that fire in the brain, and helps to induce sleep, uplift mood, and reduce anxiety.

Ashwagandha has traditionally been used to stabilize mood in patients with behavioural disturbances. Research has revealed that the herb produces an anti-depressant and anti-anxiety effect in rodents comparable to the anti-depressant drug imipramine and the anti-anxiety drug lorazepam (Ativan) Archana R (1999). In fact, Ashwagandha is one of the most widespread tranquilizers used in India, where it holds a position of importance similar to ginseng in China. It acts mainly on the reproductive and nervous systems, having a rejuvenative effect on the body, and is used to improve vitality and aid recovery after chronic illness Bhattacharya S (2013).

Research results showed that both Ashwagandha and Panax ginseng decreased the frequency and severity of stress-induced ulcers, reversed stress-induced inhibition of male sexual behavior, and inhibited the effects of chronic stress on retention of learned tasks. Both botanicals also reversed stress-induced immune suppression, but only the Withania extract increased peritoneal macrophage activity. The activity of the Withania extract was about the same as the activity of the ginseng extract. Withania Somnifera, however,
has an advantage over Panax ginseng in that it does not appear to result in ginseng-abuse syndrome, a condition characterized by high blood pressure, water retention, muscle tension, and insomnia Bhattacharya SK (2003).

**Anti-carcinogenic activity**

Ashwagandha is reported to have anti-carcinogenic effects. Research on animal cell cultures has shown that the herb decreases the levels of the nuclear factor kappaB, suppresses the intercellular tumor necrosis factor, and potentiates apoptotic signalling in cancerous cell lines Ichikawa H (2006). One of the most exciting of the possible uses of Ashwagandha is its capacity to fight cancers by reducing tumor size Jayaprakasam (2003). To investigate its use in treating various forms of cancer, the antitumor effects of Withania somnifera have been studied by researchers. In one study, the herb was evaluated for its anti-tumor effect in urethane-induced lung tumors in adult male mice Singh N (1986). Following administration of Ashwagandha over a period of seven months, the histological appearance of the lungs of animals which received the herb was similar to those observed in the lungs of control animals.

**Anti-inflammatory activity**

Research has explored the capacity of Ashwagandha to ease the symptoms of arthritis and other inflammatory conditions. These studies have proven that the herb acts as an effective anti-inflammatory agent. Its naturally occurring steroidal content is much higher than that of hydrocortisone, a commonly-prescribed anti-inflammatory Anbalangan K (1986). The effectiveness of Ashwagandha in a variety of rheumatologic conditions may be due in part to its anti-inflammatory properties. Rats given powdered root of Withania somnifera orally one hour before being given injections of an inflammatory agent over a three day period showed that Ashwagandha produced anti-inflammatory responses comparable to that of hydrocortisone sodium succinate Begum VH (2011).
Anti-aging activity

Ashwagandha was tested for its anti-aging properties in a double-blind clinical trial. A group of 101 healthy males, 50-59 years old were given the herb at a dosage of 3 grams daily for one year. The subjects experienced significant improvement in hemoglobin, red blood cell count, hair melanin, and seated stature. Serum cholesterol decreased and nail calcium was preserved. Seventy percent of the research subjects reported improvement in sexual performance Bone K (2012).

Cardioprotective activity

Ashwagandha has been evaluated in clinical studies with human subjects for its diuretic, hypoglycemic, and hypocholesterolemic effects Davis L (2000). Six type 2 diabetes mellitus subjects and six mildly hypercholesterolemic subjects were treated with a powder extract of the herb for 30 days. A decrease in blood glucose comparable to that which would be caused by administration of a hypoglycemic drug was observed. Significant increases in urine sodium, urine volume, and decreases in serum cholesterol, triglycerides, and low-density lipoproteins were also seen.

Hypothyroid activity

Animal studies have shown that Ashwagandha may have a effect on thyroid activity. An aqueous extract of dried Withania root was given to mice daily for 20 days. Significant increases in serum T4 were observed, indicating the plant has a stimulating effect at the glandular level. Withania somnifera may also stimulate thyroid activity indirectly, via its effect on cellular antioxidant systems. These results indicate ashwaganda may be a useful botanical in treating hypothyroidism Chaudhary G (2003).

Imunomodulatory activity

A series of animal studies have demonstrated Ashwagandha to have profound effects on healthy production of white blood cells, which means it is an effective immunoregulator and chemoprotective agent Kuttan G (1996). In a
study using mice, administration of powdered root extract from Ashwagandha was found to enhance total white blood cell count. In addition, this extract inhibited delayed-type hypersensitivity reactions and enhanced phagocytic activity of macrophages when compared to a control group Anbalangan K (2010). Recent research suggests a possible mechanism behind the increased cytotoxic effect of macrophages exposed to W. Somnifera extracts. Nitric oxide has been determined to have a significant effect on macrophage cytotoxicity against microorganisms and tumor cells. Iuvone et al demonstrated Withania somnifera increased no production in mouse macrophages in a concentration-dependent manner. This effect was attributed to increased production of inducible nitric oxide synthase, an enzyme generated in response to inflammatory mediators and known to inhibit the growth of many pathogens Bogdan C (2012).

Research has also shown Ashwagandha to have stimulatory effects, both in vitro and in vivo, on the generation of cytotoxic T lymphocytes, and a demonstrated potential to reduce tumor growth. The chemopreventive effect was demonstrated in a study of ashwagandha root extract on induced skin cancer in Swiss albino mice given Ashwagandha before and during exposure to the skin cancer-causing agent (7,12-dimethylbenz[a]anthracene) Davis L (2013). A significant decrease in incidence and average number of skin lesions was demonstrated compared to the control group. Additionally, levels of reduced glutathione, superoxide dismutase, catalase, and glutathione peroxidase in the exposed tissue returned to near normal values following administration of the extract. The chemopreventive activity is thought to be due in part to the antioxidant/free radical scavenging activity of the extract.

**Other Therapeutic Benefits**

Further studies have also shown ashwagandha to be effective in the treatment of osteoarthritis Angalagan K (2009), inflammation, stroke and tardive dyskinesia Chaudhary G et al. (2010). Ashwagandha has been shown to be a potential antimicrobial agent, with antifungal activity Choudhary MI
(2009), and moderate antibacterial activity against Staphylococcus aureus and Pseudomonas Aeruginosa bacteria strains Ali NA (2007).

Ashwagandha also appears to have antibacterial and antiviral properties of its own Singh at el. (2011). It increases physiological endurance and protects against the effects of stress Armen and Sandhu (2007). It works in suppressing pains of any sort, this property due to its ushan virya potency, which helps in eradicating vata that is the reason of initiation of pain in body. Works as anti-inflammatory substance therefore helps in reducing swellings and restoring blood supply Anabalgan and Sadique (1981), Aphale et al. (1998) reported in a study conducted on rats, intake of ginseng and ashwagandha for 90 days, researchers found significant increase in body weight, food consumption and liver weight, and improved hematopoiesis. They did not reveal any toxicity of brain, heart, lung, liver, spleen, kidneys, stomach, testis and ovaries. Further the side effects of WS were not significantly different from those experienced by placebo-treated individuals Cooley et al. (2009) and Chopra et al.(2004).Thus, ashwagandha probably is safe without serious side effects. There are only few scientific clinical studies showing effect of WS on selective parameter of exercise performance after regular administration when given as supplements. The present study was therefore designed and performed to assess the effects of Withania Somnifera (Ashwagandha) on the VO2 max, Sprint Fatigue Level, Core Muscle Strength & Stability, Lower Back and Hamstring Flexibility, Agility and concentration of hemoglobin in hockey players.

Statement of the Problem

“Effect of Withania Somnifora (Ashwagandha) on the physical fitness components and physiological variables in hockey players”

Objectives

1. To find out the difference in Maximal Oxygen Consumption Capacity ($VO_{2\text{max}}$ in ml/kg/min.) between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.
2. To find out the difference in Sprint Fatigue Level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

3. To find out the difference in Core Muscle Strength & Stability level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

4. To find out the difference in Lower Back and Hamstring Flexibility level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

5. To find out the difference in Agility level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

6. To find out the difference in concentration of hemoglobin present in level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

Hypothesis

1. There will be no significant difference in Maximal Oxygen Consumption Capacity (VO$_{2\text{max}}$ in ml/kg/min.) between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

2. There will be no significant difference in Sprint Fatigue Level between the control group (placebo group) and experimental group (Withania
Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

3. There will be no significant difference in Core Muscle Strength & Stability level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

4. There will be no significant difference in Lower Back and Hamstring Flexibility level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

5. There will be no significant difference in Agility level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

6. There will be no significant difference in concentration of hemoglobin present in level between the control group (placebo group) and experimental group (Withania Somnifera group) after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

**Delimitations**

1. The study was confined to 48 male hockey players (between 16 to 19 years) from Shri Guru Hari Singh Hockey Academy, Shri Jiven Nager, Sirsa, Haryana.

2. Subjects were randomly into two Group I (n=24): Withania Somnifera Group (Experimental) and Group II (n=24): Placebo (Control) group.

3. Specific variables of Physical Fitness: a) Maximal Oxygen Consumption Capacity (VO2max) in ml/kg/min. b) Sprint Fatigue Level c) Core Muscle Strength & Stability d) Lower Back and Hamstring Flexibility and e) Agility were studied.
4. Only one Physiological Variable: Haemoglobin Concentration in Blood was examined.

5. The control group (placebo group) and experimental group (Withania Somnifera group) were examined for different variables after 4 weeks and 8 weeks of placebo and Withania Somnifera supplementation.

Limitation of the study

The lifestyle, habits, heredity, nutritional intake, physical fitness level, other psychological and physiological variables are beyond control of the research worker. These were considered as limiting factors of the study.

Significance of the Study

To date, most of the properties of *Ashwagandha* have been studied, investigated and reported only in sedentary healthy/unhealthy subjects. Thus, this study was designed to analyze its effectiveness in improving Specific variables of Physical Fitness: Maximal Oxygen Consumption Capacity (VO$_{2\text{max}}$) in ml/kg/min., Sprint Fatigue Level, Core Muscle Strength & Stability, Lower Back and Hamstring Flexibility, Agility and HB concentration in well-trained athletes. This study was the first of its kind to document the significant improvements in physical fitness with regard to specific fitness variables of hockey players. Thus this study will add to the critical literature which supports the *Ashwagandha* as a potential ergogenic agent in sports.