

## A RECENT ADVANCEMENT IN HYDROXYCITRIC ACID NUETRACEUTICAL

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### ABSTRACT

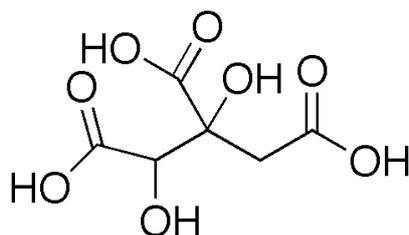
(-)- Hydroxycitric acid (HCA) is a derivative of citric acid and can be found in plant species native to South Asia such as *Garcinia cambogia*, *Garcinia indica*, and *Garcinia atroviridis*. Sometimes, it can also be found in parts of the flowers of *Hibiscus subdariffa* and *Hibiscus rosa-sinensis* plants. HCA balances stress hormone levels in our body. It plays a very important role in increasing the levels of serotonin in brain. It also acts as appetite suppressant by reducing cravings and the urge for consumption of calories. It also increases the rate of metabolism by preventing the production of enzyme that retards the rate of metabolism. Hence, it helps in weight loss by inhibiting the

calories to be converted to fat and promoting its conversion into glycogen. It also helps to develop muscles. Because of all these advantages, HCA has gained the attention of people who want to reduce their weight without many side effects. The aim of this systematic review is to examine the efficiency of HCA extracted from the *Garcinia* genus as a weight reduction agent, by studying the chronological development of HCA molecule from 1993 to 2019 which includes the isolation and purification of HCA from *Garcinia* genus, methods to improve the efficiency of HCA by using different substances like chromium, potassium salt, niacin bound chromium, mechanism involved in obesity control, effect of HCA on physical fatigue. Studying the effects of different concentration of HCA on weight loss and their market value. This paper also discusses various patents regarding food products produced from HCA, weight loss composition, production of HCA from microbes and also using them for commercial use like topical deodorant.

**KEYWORDS:** (-)- Hydroxycitric acid (HCA) is *Garcinia atroviridis*.

## I. INTRODUCTION

Hydroxycitric acid (HCA) is a chemical that is found in fruit rinds of *Garcinia cambogia* (also known as Malabar tamarind), *Garcinia indica*, and *Garcinia atroviridis*. Sometimes, it can also be found in parts of the flowers of *Hibiscus subdariffa* and *Hibiscus rosa-sinensis* plants. *Garcinia Cambogia* extract is a hub of vitamins B, Potassium, Niacin, Magnesium, Thiamine, Folic Acid, Vitamin C, Manganese, and Hydroxycitric Acid (HCA). There are 4 isomers of HCA, (+)- and (-)-allo-hydroxycitric acid and (+) and (-)- hydroxycitric acid.



Nowadays, a common desire for several people is weight loss as obesity can pose many problems like type 2 diabetes, coronary heart disease, and hypertension. With a wide range of alternatives available in the market, it is a slight difficult task for the consumers to select the right one that suits them based on the side effects, cost, and efficacy. *Garcinia Cambogia* extract powder being natural, consumer safe and with proven positive results for weight loss, has become widely popular. HCA besides its use as a flavouring agent, acts as appetite suppressant by reducing cravings and urge for consumption of calories. HCA acts as a competitive inhibitor of an enzyme called as adenosine triphosphate citrate lyase which catalyses the extra mitochondrial cleavage of citrate molecule to acetyl coenzyme A and oxaloacetate. Hence the acetyl coenzyme A pool is reduced. It is seen that when HCA is administered to the body, the rate of gluconeogenesis doubles and hence it causes appetite suppression and hence helps in burning of fat. Hence, it helps in weight loss by inhibiting the calories to be converted to fat and promoting its conversion into glycogen. It plays a very important role in increasing the levels of serotonin in brain. It also helps in the development of muscles because of its great ability to create a more efficient metabolism. Many metabolic functions have been reported regarding HCA containing products and extracts like reducing blood lipids, appetite suppression, inducing weight loss, reducing the intake of food as observed in animal trials as well as human clinical trials. Animal trials as well as test tube studies suggest few health benefits regarding HCA like decreasing insulin and leptin levels,

reducing inflammation, improving blood sugar control, increase in insulin sensitivity. It could additionally boost our digestive systems, provides protection against stomach ulcers and prevent the damage to the inner lining of digestive tract. It is also useful for the reduction as well as prevention of visceral fat accumulation and rebound effect was not observed. It is also observed to improve immune system functioning. The aim of this review is to throw light upon the developments of the HCA molecule, market demand and few important patents regarding its production, extraction, uses etc.

## II. CHRONOLOGICAL ORDER: DATE WISE

**2015-2019:** Mengling peng et.al, explained the effects of HCA on chicken embryos, using the lipid droplet accumulation, published in animal science journal.<sup>[1]</sup> N Sowmya et.al, explained the sensory evaluation and formulation of value added products, obtained using *Garcinia indica* fruit (underutilized), published in Journal of Pharmacognosy and Phytochemistry.<sup>[2]</sup>

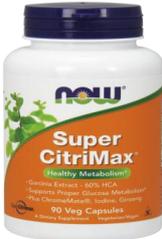
**2010-2014:** Surapaneni KM, et.al, studied the comparative effect of pioglitazone, quercetin and HCA status of antioxidant and lipid peroxidation in experimental non-alcoholic steatopneumonitis, published in The ACS journal of surfaces and colloids.<sup>[3]</sup> Abolhassani M, et.al, done the screening of drugs targeting cancer, studied in mice, published "Investigational new drugs".<sup>[4]</sup> Kirana H, et.al studied the effect of aqueous extract of *Garcinia indica* which restores glutathione in type 2 diabetic rats, published Journal of young Pharmacists.<sup>[5]</sup>

**2005-2009:** Bousova I, et.al, studied the effect of HCA and uric acid on glycation of aspartate aminotransferase by methylglyoxal, published in Molecular and cellular biochemistry.<sup>[6]</sup> Heymsfield, et.al, explained the geometric model by clinical implications, published in Nutrition and metabolism.<sup>[7]</sup> Tomohiro Sugino, et.al, explained the effects of I-Carnitine and citric acid on physical fatigue, published in Journal of Clinical biochemistry and nutrition.<sup>[8]</sup>

**2000-2004:** Saper RB, et.al, studied the Common dietary supplements for losing weight, published in American family physician.<sup>[9]</sup> Talpur N, et.al studied the effects of SX fraction of mushroom maitake, (-)-HCA and niacin-bound chromium on the aged Zucker fatty rats which are aged, published in Molecular and cellular biochemistry.<sup>[10]</sup> Jayaprakasha GK, et.al, studied on determining the organic acids present in rinds and leaves of garcinia fruit, published in Journal of Pharmaceutical and biomedical analysis.<sup>[11]</sup>

**1993-1999:** Badmaev V, et.al., studied how *Garcinia cambogia* can be used for weight loss, published in JAMA.<sup>[12]</sup> Heymsfield SB, et.al, a randomized controlled trial was done using HCA, for checking the potential of HCA for obese.<sup>[13]</sup> Badmaev V, et.al, clinical evaluation of citrin a botanical weight loss formula.<sup>[14]</sup> Conte AA, studied the alternative weight reduction therapy which is non-prescription alternative.<sup>[15]</sup>

### III. COMMERCIALY AVAILABLE PRODUCTS OF HYDROXYCITRIC ACID

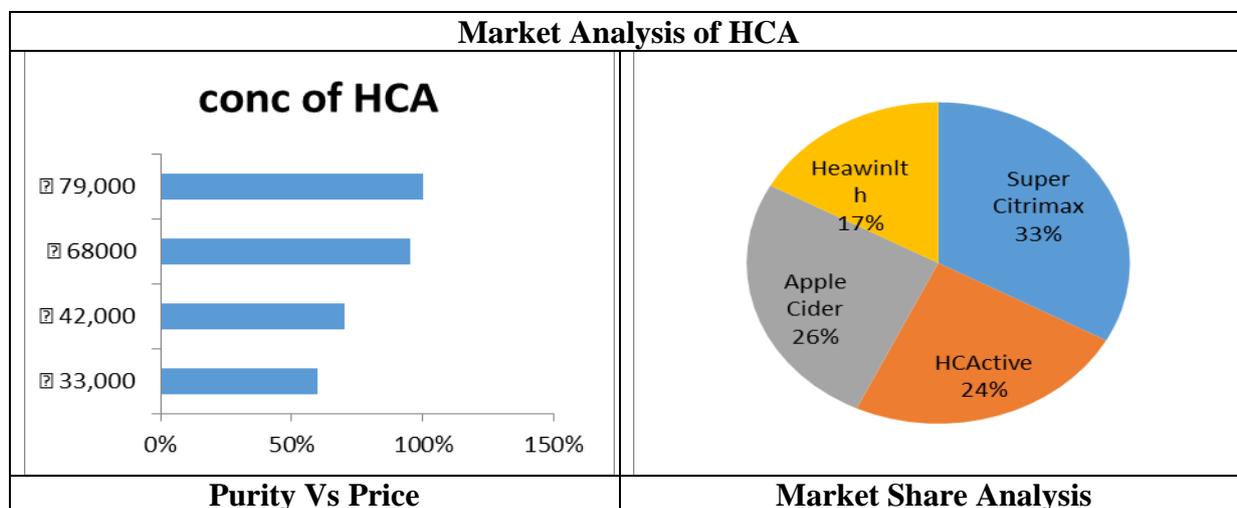
Product name and Price	Product label	Uses
<b>Herbal Hills Garcinia Powder</b> □ 1250 per kg		<ol style="list-style-type: none"> <li>1. anti-inflammatory, anti- microbial property.</li> <li>2. Increases the serotone level in brain.</li> <li>3. blocks the conversion of starch and sugar into fat.</li> <li>4. helps in weight management.</li> <li>5. Helps in balancing the pH of the body.</li> </ol>
<b>GNC Garcinia Cambogia Veg Cap 90'S.</b> (□ 1900.00)		<ol style="list-style-type: none"> <li>1. Helps in the metabolism of fat.</li> <li>2. It acts as appetite suppressant.</li> <li>3. obesity control.</li> </ol>
<b>3.Healthawin Ultra Max Pure Garcinia Cambogia Extract 95 Hca 800 Mg Fat Burner</b> □ 1800. 00		<ol style="list-style-type: none"> <li>1. help you lose weight, and it also promotes holistic health.</li> </ol> <p>It has antioxidants.</p> <ol style="list-style-type: none"> <li>2. It is a huge boost for our immune system.</li> <li>3. Helps fight free radicals</li> </ol> <p>promotes a healthier lifestyle.</p>
<b>4. Super CitriMax® Capsules</b> □ 1727.28 (90 capsules)		<p>increase the amount and storage of glycogen.</p> <p>Increases long-term energy.</p> <p>boosts appetite.</p>
<b>5.HCAActive® Garcinia Cambogia, HYDROXYCITRIC ACID GARCINIA CAMBOGIA EXTRACT</b> □ 2654.00		<p>helps in metabolism</p> <p>supports appetite.</p> <p>70% HCA concentration</p>
<b>6. Garcinia Cambogia With 95% Hydroxycitric Acid</b> □ 1734 (60 capsules)		<p>This product stops the work of enzyme citratelase which is responsible for the conversion of carbohydrate to fatty acid.</p> <p>It helps in weight management.</p> <p>It reduces Hunger and keeps a person energized. It boosts the serotone level and controls our mood. It helps in having sound sleep.</p>

#### IV. Market Value of HCA

HCA extract is available in 3 forms namely powdered, liquid and capsule. However, powdered form is extensively used. Since many people aim for weight loss these days it is slightly a difficult task for them to select the right one. HCA being natural, consumer safe and having positive results for weight loss has become widely popular and considered the best remedy for weight loss. Among the widely segmented markets online stores hold a high share in marketing and selling HCA products. Different concentration of HCA is available like 60%, 70%, 80%, 90%, 100%. However the weaker one would be 60% concentrated HCA. And the best quality would be 100% HCA concentrated form. The Market Analysis of HCA is shown in Table1 and Figure1.

**Table 1: Market Value and share of HCA.**

Concentration of HCA	Average value Perkg Based on MRP	Average value per Kg Based on Production Cost	Trade Product	Market Share in Percentage
60% HCA product	₹ 66,500	₹ 33,250	Super Citrimax	33
70% HCA product	₹ 70,791	₹ 42,474	HCAActive	24
95% HCA product	₹ 97,214	₹ 68,049	Apple Cider	26
100% HCA product	₹ 99,000	₹ 79,200	Healthwin	17



**Figure 1: HCA Market Analysis.**

## V. PATENTS

Patent Number/ Publication date	Inventors	Details
US20180256527/ 13.09.2018	DALLAS L. CLOUATRE DANIEL E. CLOUATRE BRAD J. DOUGLASS	<b>BOLUS DOSE OF HYDROXYCITRIC ACID WITH GLYCEROL.</b> <sup>[16]</sup> HCA in the form of a salt along with glycerol is more effective than only HCA delivered through two or three administrations. This method reduces the adverse effects and reverse effects. Stable salt of HCA is added to 25%v/v glycerol in water resulting in 1.4 molar±20%, ±10%, ±5% concentration of HCA. A flavoring agent may as well be added. K-Mg salts of HCA (69.7% HCA)+limonene+glycerol+pure water. 5ml of this formulation supplies 1500mg of HCA salt. All the clinical trial showed better mental aquity, widely awake, greater endurance, no reverse effects, very useful for the athletes.
US20110236506A1/ 29.09.2011	Laurent Schwartz, Paris(FR); Adeline GUAIS- VERGNE, Draveil,(FR).	<b>PHARMACEUTICAL ASSOCIATION CONTAINING LIPOIC ACID AND HYDROXYCITRIC ACID AS ACTIVE INGREDIENTS.</b> <sup>[17]</sup> This combination has high antitumor activity and stabilizes its effect greater than that obtained by anticancer medicaments. Preferably type of lipoic acid and 2S, 3S of HCA are used. Lipoic acid must be between 20-800mg, HCA between 200-2000mg, administered 2-3 times a day. Along with this combination, another active acceptable excipients can be added. Tests on human tumor cell lines in the combined form showed 80% cell mortality. Anti tumor activity tests on mice C3H with the combination increases the life span of mice to some extent. In humans, diseases like metastatic breast cancer, parotid gland cancer were stabilized.
US2007/0031526 A1/ 08.022007	Shyam k Gupta, Scottsdale, AZ(US)	<b>TOPICAL DEODRANT COMPOSITIONS BASED ON HYDROXYCITRIC ACID.</b> <sup>[18]</sup> HCA, derivatives of HCA finds its use in cosmetics, pharmaceutical products which helps reduce body stench. They give benefits for deodorant for topical applications. These have all the required properties of ingredients of deodorants. HCA reduces triglyceride content in sweat by penetrating from topical compositions which might be because of the inhibition of citrate lyase enzyme. It also decreases generation of low molecular weight compounds that result in inhibiting the bacteria on skin surface. These deodorants were prepared by different methods with different organic bases all of which showed a reduction in body odour.

JP2005058161A/ 03.10.2005	Hiroyuki Hida, Takashi Yamada, Yasumichi Yamada	<p><b>METHOD FOR PRODUCING HYDROXYCITRIC ACID.</b><sup>[19]</sup></p> <p>The paper deals with the production of HCA by fermentation using microorganisms. Streptomyces G3 strain, microbacterium GD88A and bacillus G45C strain are few microbes involved in the production of HCA. This invention describes the method which involves culturing HCA producing microbes in a medium containing carbon source that acts as a precursor for HCA. the medium is neutral or slightly acidic. yeast extract, meat extract, peptones can be added to promote the generation of HCA. culturing can be carried out by submerged aeration agitation culture. the temperature is maintained between 25-30 degree celcius for 2-10 days. this produces significant amount of HCA. Different separation techniques like centrifugation is used to recover HCA from the culture as crystals. The purified HCA is then analysed using NMR spectrometer.</p>
US005656314A/ 12.08.1997	Scott Alexander Moffet, Calif. Ashok Kumar Bhandari, India Bhagavathula Ravindranath, India Karanam Balasubramanvam, India.	<p><b>HYDROXYCITRIC ACID CONCENTRATE AND FOOD PRODUCTS PREPARED THEREFROM.</b><sup>[20]</sup></p> <p>The concentrate consists of 23 - 54% by weight of HCA, 6-20% of lactone of HCA, 0.001-8% of citric acid, 32-70% of water, wherethe free HCA, lactone of HCA and citric acid consisits of 94-99% of the total solutes dissolved in water. It also relates to a process of enriching the extract by Getting a salt free extract, Loading the extract for an anion exchange column, Eluting HCA from anion exchange column with group IA metal hydroxide, To collect hydroxyl-ycitric acid as a free acid in second solution. It also shows how fiber snack bars and beverages are prepared from HCA.</p>

## VI. CONCLUSION

Nutraceutical industry being one of the recent flourishing industries and companies' and scientists' interest for establishing scientific integrity has attained great importance. Recently, many clinical trials have been performed to explain the practical effects of HCA supplementation on assisting the development of human health. HCA is an industrially important nutraceutical, plays an important role in the medical treatment such as for control of obesity, physiological improvement in the cancer patient. Particularly, extensive research is concerned with the effects of HCA on antiobesity. These have resulted in the production of various products that are involved in weight management. To note, the application of HCA are many but few to highlight is antiobesity, antitumor, antidiabetic, antiageing, antidiuretic etc. We have previously reviewed many patents and research work of many authors and have found, the HCA molecule from its time of discovery to recent advancements, we can state that HCA has gained industrial importance which is market driven. Few of the patents on different aspects of HCA include increasing extraction and production of HCA, dietary

supplements prepared from it, production techniques and their commercial uses. Supplements of HCA act as efficient tools to curb several health problems mainly obesity which is proven on a large scale by long term clinical trials. Various dietary supplements are usually found to be more effective as a combination of ingredients than its effect as a single agent. As a result it is slightly difficult to examine the effectiveness as a single agent. Hence the review of this paper will enlighten on the HCA importance, its industrial application and the market value. The approximate market values for different compositions of HCA have been examined and tabulated along with the representation of those values with the help of a graph. Along with this, awareness of safety and its efficacy of the dietary supplements made available should be promoted among the health care sectors to assist the patients in understanding the benefits of the same. Thus, investigations are to be conducted on herbal preparations scientifically for new alternative therapies to be discovered.

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