



Seasonal Consumption of *Terminalia chebula* Retz-An Ayurvedic Sovereign Remedy in Non Communicable Diseases (NCDs): A Literary Review

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Abstract

Glycoxidation, increasing number of AGEs, oxidative stress, Reactive Oxygen Species (ROS) throughout year plays decisive role in the development of Non Communicable Diseases (NCDs). In the present study I have discussed about their effective and economical management based on the principle of Ayurveda in the form of 'Seasonal consumption of *Terminalia chebula* Retz'. With so many benefits concealed inside, the single drug *Terminalia chebula* from this concept is having remarkable potential regarding antiglycating activity by the means of breaking cross-links of proteins induced by AGEs, inhibition of AGE formation, blockade of the AGE-RAGE interactions, suppression of RAGE expression and prevention from glycer-AGEs-induced ROS formation ensuring good control over intricate pathology like Non Communicable Diseases (NCDs) slowly footing towards everyone of us.

Only the integrated approach towards this gruesome situation will going to help mankind and this small piece of work can unquestionably lend a hand to revolutionize the future scenario of these tribulations. May this study of 'Seasonal consumption of *Terminalia chebula* Retz.' rewarding all the necessities of treatment regime could serve as a light of hope towards search of ideal treatment of Non Communicable Diseases (NCDs).

Keywords: Seasonal consumption of *Terminalia chebula* Retz; Advanced glycation end products (AGEs); Non communicable diseases (NCDs)

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Received Date: 04 Apr 2019

Accepted Date: 15 May 2019

Published Date: 17 May 2019

Citation:

Giri RD. Seasonal Consumption of *Terminalia chebula* Retz-An Ayurvedic Sovereign Remedy in Non Communicable Diseases (NCDs): A Literary Review. *Ann Clin Diabetes Endocrinol.* 2019; 2(1): 1010.

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Introduction

Economic development has led to higher rates of lifestyle changes, with these changes a crop of diseases occurs. These diseases have been called 'lifestyle diseases' or 'disease of civilization and 'disease of longevity'. Most people do not even know that they are creating stage for the development of these diseases through their daily activities [1]. The World Health Organization has informed that 'lifestyle' diseases are becoming a serious threat to the people of Asia-Pacific, even if they can control more conventional diseases [2]. Uncontrolled continued exposure to oxidative stress is a precursor to many chronic diseases. Of the many known mediators of oxidative stress, Reactive Oxygen Species (ROS) and Advanced Glycation End Products (AGEs) are the most studied [3]. Stresses derived from aging and lifestyle changes cause tissue damages. These damages are generally repaired by homeostatic mechanisms, in which various types of cells react to stresses and promote tissue remodeling through intercellular communication, thereby maintaining tissue homeostasis. However, alteration of these mechanisms leads to the pathologic tissue remodeling and results in pathogenesis and progression of lifestyle diseases, (Figure 1) this consequently can initiate a cascade of events, which includes the activation of signal transduction pathways, which activate inflammatory responses causing tissue damage [4,5].

More recently, a role for Advanced Glycation End-products (AGEs) in the development of arterial stiffening has been suggested, mechanisms underlying these alterations include AGE cross-linking of collagen and AGE interactions with circulating proteins and AGE receptors. New pharmacologic agents that prevent AGE formation, break cross-links, or block AGE receptors reduce vascular and myocardial stiffness, inhibit atherosclerotic plaque formation, and improve endothelial function. These agents promise to reduce the risk of isolated systolic hypertension, diastolic dysfunction, diabetes and thus, heart failure [6]. AGEs accumulate in our tissues and organs over time and contribute to the development and complications associated with diseases

Table 1: Seasonal consumption of *Terminalia chebula* Retz in Indian seasons.

Indian season	Adjuvant
Rainy season (<i>Varsha</i>)	Rock salt
Autumn season (<i>Sharad</i>)	Sugar
Early winter season (<i>Hemant</i>)	Dry ginger
Winter season (<i>Shishir</i>)	<i>Piper longum</i>
Spring season (<i>Vasant</i>)	Honey
Summer season (<i>Grishma</i>)	Jaggery

of advancing age including diabetes, cardiovascular disease, renal failure, arthritis and neurodegenerative disorders [7]. When examined in a matched cohort of patients, high AGE levels in the serum correlated with high AGE accumulation in cancer tissue [8]. Their (AGEs) accumulation *in vivo* has been implicated as a major pathogenic process in diabetic complications, including neuropathy, nephropathy, retinopathy and cataract and other health disorders, such as atherosclerosis, Alzheimer's disease and normal aging [9-14]. Reactive Oxygen Species (ROS) formed during the glycation process could cause oxidative stress and damage to tissues, which are also common end points of the above diseases [15-17]. AGE modifications not only change the physicochemical properties of the afflicted molecules but also induce cellular signaling, activation of transcription factors and subsequent gene expression *in vitro* and *in vivo* [18]. In diabetes, the glycation of myelin has been found to be increasing as well. AGEs on myelin could trap plasma proteins such as IgG and IgM to elicit further immunological reactions, contributing to both nerve and neuronal demyelination in diabetic neuropathy [19,20]. Furthermore, the glycation and AGE formation occurred on DNA and histones could bring about errors in replication and transcription thereby promoting mutations responsible for diabetic embryopathy [21]. Once formed, AGEs may continue to take part in a covalent cross-link with proteins which are generally stable and long lived, such as collagen and crystalline [18]. Whatever condition it is, the formation of AGEs is influenced by several factors, like sugar concentration, chemical structure, turnover rate of targeted protein and the degree of oxidative stress in the environment [22-24].

Substances that inhibit AGE formation, reduce oxidative stress or destroy already formed cross links may limit the progression of disease and may offer new tools for therapeutic interventions in the therapy of AGEs mediated disease [25]. Unless and until we are not living in harmony with nature and our constitution, we cannot expect ourselves to be truly healed. Ayurveda gives us the means.

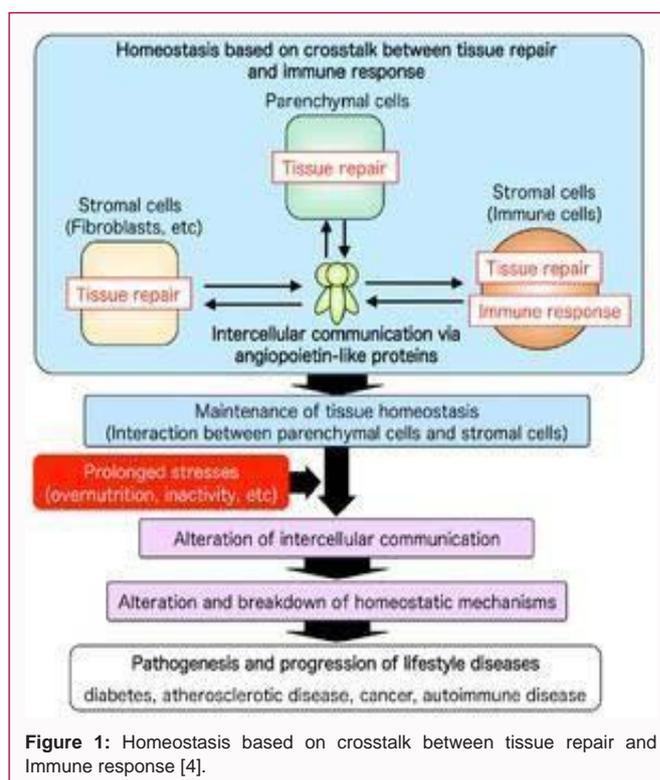
Aim

The aim of this study is to find out cost-effective, precautionary and therapeutic strategy for Non Communicable Diseases (NCDs) from Ayurveda.

Discussion

The strategy that work along with inhibition of Glycooxidation, AGE formation, blockade of the AGE-RAGE interaction and suppression of RAGE expression or its downstream pathways, prevents glycer-AGEs-induced ROS formation on one hand and also possess strong Antioxidant activity on the other may be novel therapeutic strategy against intricate and progressive pathology of Non Communicable Diseases (NCDs) throughout year.

So far, both synthetic compounds and natural products have been evaluated as inhibitors against the formation of AGEs. Although

**Figure 1:** Homeostasis based on crosstalk between tissue repair and Immune response [4].

some synthetic molecules have demonstrated strong power to inhibit the formation of AGEs or break AGE-induced cross links, they might also cause side effects as well [25-27]. When compared to synthetic compounds, natural occurring products have been proven relatively safe for human consumption. In this regard, some plant extracts and their relevant phenolic ingredients have been evaluated for their effects on the formation of AGEs in recent years and showed potent anti-glycative effects which are mainly due to their strong antioxidant activities [28-30].

Plausible role of seasonal consumption of *Terminalia chebula* Retz in Non Communicable Diseases (NCDs): In this entire concept the drug *Terminalia chebula* is alone potent AGE inhibitor prevents glycer-AGEs-induced ROS formation as well as strong Antioxidant Chebulagic acid is a potent inhibitor cross-linking and breaker of collagen cross-linking, Protective role of Chebulagic acid against AGEs induced endothelial cell dysfunction was also reported (Table 1) [31-37]. *Terminalia chebula* is a potential source of natural antioxidants which have free radical scavenging activity and might be used for reducing oxidative stress [35]. Many reports have alluded to the potential of *Terminalia chebula* as a potent Antioxidant [35,37]. Upon investigating the protective activity of *Terminalia chebula* extract against AGE-induced vascular endothelium dysfunction, Human Umbilical Vein Endothelial Cells (HUVEC) incubated with 100 µg/mL of AGEs had significantly enhanced Reactive Oxygen Species (ROS) formation, whereas the treatment of *T. chebula* reduced AGE-induced ROS generation [34]. Many reports have advocated the nutraceutical potential of *Terminalia chebula* [38,39]. With an advantage of all the above properties of *Terminalia chebula*, Bhavmishra added some adjuvant drugs (Table 2) to this theory in order to enhance its effects. *Terminalia chebula* herb is extolled for its effect as a rejuvenative therapy [56]. The seasonal use of this Ayurvedic herb can be one of the cheapest and effective tools to elevate the health, detoxification of the body and keep you free from

Table 2: Adjuvant (Properties/uses and possible mechanism).

Sr. No	Botanical Name/ English Name	Possible Mechanism of Action/Uses	References
1	<i>Zingiber officinale</i>	-Acts on TEF resulting in feeling of satiety	22538118 [40]
		-Improves insulin sensitivity	24490949 [41]
		-Antihyperlipidemic	18813412 [42]
2	<i>Piper longum</i>	-Potential DGAT inhibitors	17177498 [43]
		-Antioxidants, antidiabetic and anti obesity potential	26028738 [44]
		-Neuroprotective & antioxidant	[45]
		-Protective activity in case of myocardial ischemia	[46]
		-Antidiabetic and antihyperlipidemic	[47]
3	Jaggery	-Rich in mineral salts	
		-Treats throat and lung infections	[48]
		-Sulphur less Organic composition, a best to suite as preferred health alternative.	
		-Easy to digest	
		-Jaggery is loaded with antioxidants and minerals like zinc and selenium, which help prevent free-radicals (responsible for early ageing). It prevents constipation by aiding Digestion	[49]
4	Honey	-Increases tumor necrosis factor- α and reduces high sensitive C-reactive protein	28351393 [50]
		-Honey intervention in a group of children with Acute Lymphoblastic Leukemia (ALL) resulted in positive effects on Febrile Neutropenia (FN) and hematologic parameters	[51]
		-Honey associated with a reduction in weight and improvements in lipid parameters	25986159 [52]
		-Effective against radiochemotherapy induced mucositis in head and neck cancer.	18485252 [53]
5	Rock salt	-Improves Digestion and is a natural way to relieve stomach pain.	
		-Boosts Metabolism	
		-Stabilizes Blood Pressure	
		-Boosts Immunity	[54]
		-Treats Sinus	
		-Promotes Weight Loss	
		-Reduces Edema	
		-Promotes Sleep	
-Reduces Stress			
6	Sugar	-Pouring granulated sugar on wounds 'can heal them faster than antibiotics'	[55]
		-Sugar May Help Heal Wounds	[56]

diseases. It acts as Preventive, Curative and Rejuvenative medicine [57]. This will unquestionably lend a hand to revolutionize the future scenario of the Non Communicable Diseases (NCDs). Seasonal consumption of *Terminalia chebula Retz.* can be used in patients with Non Communicable Diseases (NCDs) so that the prevention from Glycoxidation, glycer-AGEs-induced ROS formation, inhibition of AGE formation, blockade of the AGE-RAGE interaction and suppression of RAGE expression can be accomplish.

The entire perception 'Seasonal consumption of *Terminalia chebula Retz.*' thus rewarding all the necessities of treatment regime mentioned above can be worth for the management of Non Communicable Diseases (NCDs) by countering their intricate pathology [58].

I conclude this literary review with the quote of David Bloom, member of the World Economic Forum Global Health Advisory Board and professor at the Harvard School of Public Health, he

said...."The challenge of non-communicable diseases goes beyond health ministries. Policy-makers must understand that these diseases pose a significant threat to personal as well as to economic well-being and progress. Non-communicable diseases undermine productivity and result in the loss of capital and labor.

These costs are unbearable and clearly call for innovative solutions and an all-of-society approach, with strong partnerships between government, the private sector and civil society".

Conclusion

Systematic review of literature indicated that the consorted approach of management explored may serve as a light of hope towards search of ideal treatment of Non Communicable Diseases (NCDs). The 'Seasonal consumption of *Terminalia chebula Retz.*' which is useful in prevention from Glycoxidation, glycer-AGEs-induced ROS formation, inhibition of AGE formation, blockade of

the AGE–RAGE interaction and suppression of RAGE expression may limit the progression of Non Communicable Diseases (NCDs) and may offer new tools for therapeutic interventions in the therapy of AGEs mediated disease, further preclinical and clinical studies are warranted to establish the effectiveness, cost-benefits and to explore clinical end points.

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