



Review Article

A CRITICAL APPRAISAL ON AGEING PROCESS IN AYURVEDA

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ABSTRACT

Ayurveda being essentially the science of life and longevity narrates all aspects of life and puts special emphasis on *Jara* (ageing). The world population of the elderly is increasing and by the year 2030, older persons are projected to account for one in six people globally. Ageing is a process of unfavorable progressive changes associated with decline in vigor and ending in death. It is an irreversible and inevitable process and has multidimensional aspects. Everyone must undergo this phase of life at his/her own life. In Ayurveda, *Jara* (ageing) is clearly defined as that which has lost age means become old by the act of degeneration of bodily tissues and organs. It is described of two types- *Kalaja jara* and *Akalaja jara*. The *Kalaja jara* (timely ageing) can be regarded as chronological ageing where *Dhatukshaya* occurs whereas the *Akalajajara* (premature ageing) which occurs untimely i.e., before its prescribed time it can be regarded as biological ageing and is more intense than that of the chronological ageing. Several concepts are reported in Ayurveda regarding ageing process e.g, decade wise ageing process is described by *Acharya Vagbhat* and *Sharangdhara*. According to them one particular bodily feature is being degraded by each decade of lifespan, in the same way multiple theories are also analyzed in contemporary science. The whole biology of ageing has been dealt in present article within the Ayurvedic frame.

KEYWORDS: Ageing process, *Jara*, *Kalaja jara*, *Akalaja jara*, Ageing theories.

INTRODUCTION

The recent years have shown significant increase in the number of elderly in the population worldwide due to the declining birth rate and increasing life expectancy. However, elderly are a precious asset for any country. With rich experience and wisdom, they contribute their might for sustenance and progress of the nation. Though growing old is a part of life cycle, a strong group of above 60 years of age is building-up to cause further challenge to the medical world which is reflected in the socio-economic progress of countries. In 2015, one in eight people worldwide was aged 60 years or over. By 2030, older persons are projected to account for one in six people globally. By the middle of the twenty-first century, one in every five people will be aged 60 years or over^[1]. This demographic shift compels us to confront the changes associated with ageing. This offers an opportunity to gather the scattered matter spread over many Ayurvedic classics and other sources of information. This call for intensive study of the factors which play the key role in progressive ageing process that can help to combat the progression of morbidity due to ageing.

OBJECTIVE

To appraise, discuss and elaborate various Ayurvedic concepts related to ageing process.

MATERIAL AND METHODS

Literature regarding the various aspects of *Jara* (ageing) was thoroughly screened from various Ayurvedic texts, online journals. Contemporary literatures which could be used to justify its relevance in current scenario were also explored.

Concept of Ageing in Ayurveda

In Ayurveda ageing is known as *Jara*, defined as that which has lost age means become old by the act of degeneration of bodily tissues and organs^[2]. *Jara* is one of the naturally occurring diseases (*Swabhavika vyadhi*) of life after 70 years, where there is improper nourishment occurring due to flaccid state of body tissues^[3]. Its synonym is "*Vridhdha*" which means increasing age^[4]. In modern medicine ageing is a complex phenomenon generally defined by gerontologists as a process that results in an age-related increase of death rate or failure rate. Biologists define ageing as the sum total of all changes that occur in a living organism with the passage of time and lead to a decreasing ability to survive stress, functional impairment and death^[5].

The definition of the word 'Jara' according to different classical literature are listed below:

Jara means graying of hairs, beard, frailty^[6], and degeneration of bodily organs^[7]. *Dalhana* opines that *Jara* is defined as a *Vata* dominant stage occurring in spite of prevention and is *Upachararahita* (untreatable), *Yapya* (palliable), *Kalakritvyadhi* (occurring with time) and requires extreme rejuvenation (*Atyantika rasayana*) to reverse agony^[8]. It is third stage of life^[9] which appears before death. Similarly *Bhavamishra* defines *Jara* as a progressive deteriorating stage of life, characterized by decline of *Dhatu*, *Indriyas*, *Bala*, and presence of *Vali*, *Palitya*, *Khalitya*, *Karma akshamata*, *Kasa* and *Shwasa*^[10].

Vaya

To understand the concept of *Jara* the knowledge of *Vaya* and its *Avastha* is essential because all classical literature of Ayurveda defines *Jara* on the basis of *Vaya*-

- *Charaka samhita* defines the *Vaya* as a factor dependent on *Kala pramana vishesha* i.e., quantum of time duration^[11].
- *Vaya* is the time bound changes occurring in the body (A.D. on A.H. Sha.3/10).
- In the present era (*Kaliyuga*), the human life span has been considered as 100 years^[12].

Avastha Of Vaya

Ayurvedic texts divide human life span into three major categories- *Balya*, *Madhya* and *Vridhdha* based on chronological age. There are some difference of opinions regarding these *Avasthas* in different *Samhita*, which are tabulated below:

Table1: Showing Avastha of Vaya

Samhitas	Avasthas of Vaya				
	Balya	Yuva	Maddhyama	Vridhdha	Ayupramana
<i>Charaka samhita</i> ^[13]	1-30 yrs.	-	30-60 yrs.	60-100 yrs.	100 yrs
<i>Sushruta samhita</i> ^[14]	1-16 yrs.	-	16-70 yrs.	70-100 yrs	100 yrs
<i>Kashyapa samhita</i> ^[15]	1-16 yrs.	16-34 yrs.	34-70 yrs.	70-100 yrs.	100 yrs
<i>Astanga samgraha</i> ^[16]	1-16 yrs.	-	16-60 yrs.	60-100 yrs.	100 yrs
<i>Astanga hridaya</i> ^[17]	1-16 yrs	-	16-70 yrs.	70-100 yrs.	100 yrs
<i>Bhavaprakasha</i> ^[18]	1-20 yrs.	-	20-70 yrs.	70-100 yrs.	100 yrs.
<i>Chakrapani</i> ^[19]	1-36 yrs 1-25 yrs.	- -	36-72 yrs. 25-50 yrs.	72-120 yrs. 72-80 yrs.	120 yrs. <i>Pravaraayu</i> 80 yrs. <i>Madhyamaayu</i>

Types of Jara

Kalaja Jara (Physiological Ageing)

Appearance of sign and symptoms of ageing at a particular scheduled age is considered as *Kalajajara*. After 70 years it is inevitable and there are no ways to prevent its occurrence. It occurs at the proper age even after following the daily and seasonal regimen mentioned in *Swasthavritta*, hence it is called as '*Parirakshanakruta*' and it can be regarded as chronological ageing where *Dhatukshaya* occurs.

Akalaja Jara (Premature Ageing)

Jara occurring before its prescribed time and appearance of sign and symptoms of ageing prior to schedule age is considered as *Akalajajara* (premature ageing). *Acharya Dalhana* opines that this type of ageing is acquired one. Hence he called it as "*Aparirakshanakruta*" that means it occurs by following improper health care measures. It can be regarded as biological ageing and its effect is more intense than that of the chronological ageing. *Chakrapani* considered the occurrence of premature

ageing in persons having features of short life span (*Avaraayu*). The ageing process generally progresses slowly and starts at the age of about 60 and its effects are quite visible at the age of 70 years. *Acharya Charaka* being a physician might have appreciated the changes of ageing at their starting point and therefore he has taken 60 years and above as the old age. In the same way *Acharya Sushruta* might have thought it safer to take the limit of ageing as 70 years when most of the symptoms of ageing are quite visible. Hence premature ageing is that which occurs before the age 60 years. These days, stress is increasing in all the field of human life, ageing may start very early. Now a day some symptoms of ageing are also seen at before 30 years.

Accelerating Factors of Ageing Process

No specific etiological factors of *Kalajajara* have been described as such in any of the Ayurvedic classics. But, there are some factors, which can be considered favorable in this regard. Those factors are:

Kala

Transformation is the hallmark of time, everything that is living undergoes various changes before it is worn out completely. This cycle of changes is known as *Parinama* in Ayurveda which takes place under the constant influence of *Kala*. The sequential events of *Balya*, *Tarunya*, *Youvana*, *Proudha*, and *Vardhakya* are all consequential eventualities of *Kala*. Therefore Ayurveda recognized *Kala* or *Parinama* as the potential causative factor of degenerative diseases entities^[20].

Sushruta Samhita also emphasized the involvement of *Kala* in the development of an individual or ageing process. It explains that because of time factor, there will be appearance of secondary sexual characteristics in an individual. This indicates that the childhood has landed up into stage of puberty^[21]. From the foregoing quotations, it is evident that *Kala* which cannot be stopped at any cost is an important cause of ageing process. Thus it can be summarized as, the growth and senescence occurs naturally as time passes.

Swabhava

Literally, *Swabhava* means the 'inherent property' or 'innate property' or 'by nature itself' or 'natural constitution'. The nature's unique process which is invisible can be called as *Swabhava*. *Charaka* has explained the theory of *Swabhavoupamavada* i.e. "there is a causative factor for the manifestation of beings but no causative factor as such exists for their deterioration". That means the process of deterioration occurs naturally^[22]. The growth and development of body parts from the time of conception till the death of an individual is a natural phenomenon. Moreover, *Sushruta Samhita* adds saying that *Jara* (old age) is a *Swabhavika vyadhi* or *swabhavabala Pravrutta vyadhi*^[23] i.e., *Jara* occurs by nature itself which cannot be stopped by any intervention. Thus *Swabhava* can be considered as a responsible factor in the causation of *Jara* which is invisible and nature's unique process.

Dosha

In Ayurveda, the phenomenon of ageing is also related to principle of *Tridosha*. The *Tridosha* (*Vata*, *Pitta* and *Kapha*) is the most important factor in maintenance of good health and causation of disease. *Tridosha* exists in the body all the time but it varies as per age, day or night period and after taking meals. Among *Tridosha*, *Vata* is the most important factor to be considered in old age, obviously because of its natural predominance at this stage of life. *Chakrapani*, justifying the importance attached to *Vayu* clarified; *Vayu* is the '*Niyanta*' i.e. which governs the unity of the components of *Ayu* such as *Shareera*, *Indriya*, *Satva* and *Atma*, hence *Vayu* itself may be

called as *Ayu*^[24]. *Sushruta Samhita* explains that *Vata* is responsible factor for creation, maintenance and destruction of all beings^[25].

In *Charaka Samhita Sankhyashareera Adhyaya*, it is mentioned that, the body is made up of *Paramanus* which are *Atibahu*, *Atisookshma* and *Atindriya*. Commenting on this *Chakrapani* opines that the combination of *Paramanus* is responsible for *Shareerarambha* (growth of the body) and their division for *Shareeravinasha* (degradation of body tissue)^[26]. *Acharya Charaka* further opines that this process occurs naturally with the help of functional unit of *Vata* because the *Samyoga* and *Viyoga* are the functions of *Vata*^[27].

Shareera Vriddhikarabhava Abhava

Acharya Charaka mentioned 4 factors, the presence of which represents growth, whereas the absence representing the senescence^[28].

1. Kalayoga (Time Bound Phenomenon)

Chakrapani says that, up to the age of 17 years the youth phase itself is a time bound factor (i.e. *Kalayoga*) which enables the body to attain growth^[29]. The exact opposite to the above, the body starts deterioration after age of 70 years, leading to senility.

2. Swabhava Samsiddhi (Natural Factor)

The invisible (*Adrutha*) nature's unique process which is responsible factor for both growth and deterioration of the body^[30].

3. Ahara Soushthava (Dietary Factor)-

Diet is the most important factor in controlling the ageing process and even its onset. *Charaka Samhita* opines that *Aharasoushthava/Aharasampat* is responsible for the proper growth and development of the body^[31]. *Matravatahara* is responsible for healthy ageing (*Sukhayu*) and longevity (*Dheergayu*). *Amatravat Ahara* leads to pathological ageing (*Dukhayu*) and shortens the span of life (*Alpayu*). The unhealthy dietary habits cause *Vata vriddhi*, *Dhatu-kshaya*, and *Agni-vaishamy* resulting in production of *Ama* (free radicals) accelerated aging^[32].

4. Avighata (Avoiding Physical and Mental Stress)-

It is necessary to avoid physical and mental stress for the proper growth and development^[33]. So absence of these favorable condition for growth, may lead to accelerate the ageing process.

5. Sahaja Theory- *Charaka* opines '*Prakriti guna sampat*'^[34] i.e. constitutional compactness is one of the prime factors required to achieve long life span, which is genetically determined as explained by *Chakrapani*. *Chakrapani* adds further that the nature (*Swabhava*) of a particular

individual depends upon the invisible factors, which are genetically carried out by that particular race in which he is born. The word "Prakriti" here denotes both the nature of a particular species and the nature of an individual within that particular species. For example, the onset of ageing process differs from one species to another. Similarly, within the species also, the nature of an individual varies according to *Desha*, *Kala*, *Prakriti*, *Ahara* etc. and accordingly ageing process may initiate early, timely or late. *Sarvadhatu sara* i.e., compactness of all body tissue is another condition in which the onset of ageing will be delayed i.e. *Manda jara* and *Chiranjivi* explained by *Charaka*^[35].

Chakrapani opines that the time of onset of *jara* (ageing) varies from individual to individual. It may be delayed in persons having the features of long life span (*Dheergayu*), whereas early in persons having the features of medium life span (*Madhyamayu*) and short life span (*Avarayu*)^[36]. To summarize, the onset and progress of ageing depends on the factors like *Prakriti* (constitution) and *Sara* (compactness of body tissue) which are genetically predetermined.

6. **Rasa Shoshana-** *Bhava Mishra* narrates that vitiated *Vata* brings the *Shoshana* of *Poshaka rasa* after the middle age i.e. errors in nourishing elements, which results in inadequate nourishment to the tissues and leading to improper *Dhatu* formation leading to ageing due to *Dhatukshaya*^[37].

7. **Dhatu Asamata-** *Sushruta* describes that due to increased *Vata* the *Adi-dhaturasa* itself is malformed and does not perform its function of "Preenana" to the rest of the *Dhatu* and the body. *Dalhana's* commentary on this adds that under this state nourishment will be inadequate (*Eeshat*) and only maintains minimal cellular functions^[38].

8. **Agni Asamata-** *Charaka* explains that the *Bala*, *Varna*, *Shourya*, *Ojus*, and *Ayu* (longevity) are due to sound functional condition of *Agni*^[39]. But after the middle age naturally *Agni-vaishmyata* occurs, which results in improper *Dhatu* formation due to improper digestive and metabolic activities, which ultimately results in *Jara*.

9. **Oja Kshaya-** *Oja* is the essence of the *Saptadhatu* and is responsible for *Shareerasthairya* (compactness of body elements)^[40] by providing adequate nutritional defense to body elements. The *Kshaya* of the *Saptadhatu* naturally leads to *Ojavikriti* leading to *Ojokshaya*. Depletion of *Oja* leads to degeneration of body.

Thus, the ageing (*Jara*) is an inevitable process, involves structural and functional changes in the body. *Ojus* has been considered with respect to the ageing process. This unique concept, hidden in Ayurveda shows that the methods to minimize or delay the inevitable process are already known by the ancient *Acharya* and was the secrets behind a healthy longevity.

Apart from these *Acharya Sharangdhara* has described decade wise decline of tissue functioning during ageing process^[41] as followings-

Table 2: Showing decade wise decline of tissue functioning during ageing process

Age	Decline of functional domain	Modern corollary
10 years onwards	<i>Balyam</i>	Childhood
20 years onwards	<i>Vridhhi</i>	Growth
30 years onwards	<i>Chhavi</i>	Skin glow
40 years onwards	<i>Medha</i>	Cognitive capacity
50 years onwards	<i>Tvaka</i>	Skin luster
60 years onwards	<i>Drishti</i>	Visual acuity
70 years onwards	<i>Shukra</i>	Virility
80 years onwards	<i>Vikram</i>	Courage
90 years onwards	<i>Buddhi</i>	Intellect
100 years onwards	<i>Karmendriya</i>	Physical mobility

Thus it is indicated that continuous catabolic process are taking place in the body and it happens due to *Parmanuvibhaga* (degradation of body elements)^[42].

Etiology of Akalaj-Jara

While describing the scope of *Rasayana chikitsa* that aids in regeneration of *Dhatus*, *Charaka Samhita* states that the chief contributing factor responsible for deterioration of the body is 'Gramyavasa dosha.' All morbidities arise due to

Gramya ahara including eating *Amla* (sour), *Lavana* (saline), *Katu* (pungent), *Kshara* (alkaline), *Shushkashaka* and *Mamsa, Tila* and *Pishtannabhojan, Virudha, Navashuka* and *Shamidhanya* (germinated or fresh monocots and dicots), *Virudha, Asatmyabhojana; Klinna* (decomposed), *Guru* (heavy), *Putiparyushitabhojana* (putrefied and stale food items), *Vishamashana* (indulging in irregular diet or eating while the previous food is undigested), *Divaswapna, Ativyavaya, Atimadyapana*, performing irregular and excessive exercise causing *Sankshobha* (agitation) in the body and also person affected with *Bhaya* (fear), *Krodha* (anger), *Shoka* (grief), *Lobha*, and *Moha*^[43].

According to *Rasaratna samuchchaya* causes of *Akalajajara* are as followings^[44].

- i. *Panthanamatigamana* i.e. Excess walking
- ii. *Atisheeta sevana* i.e. Excessive cold intake
- iii. *Kadanna sevana* i.e. Unwholesome food
- iv. *Vruddhoanganasatatasanga* i.e. Excessive indulgence in sex with elderly woman.
- v. *Manapratikula* i.e. Mental stress.

Some etiological factors of *Akalamrutyu* (untimely death) may be considered as etiological factors for *Akalajajara*^[45] i.e. *Ayathabalarambha* (over strain), *Ayathagniabhavaharana* (eating in excess to one's own digestive power), *Vishama-abhyavaharana* (eating in disproportionate to one's own digestive power), *Vishamashareerasana* (irregular posture of the body), *Atimaithuna* (excessive indulgence in sexual activity) *Asatsamshraya* (association with wicked persons), *Udirnavegavinigraha* (Non suppression of suppressible urges) *Vegavidharana* (suppression of natural urges), *Ahara pratikaravivarjanam* (avoidance of food and medicine) and when the diseases like fever are not treated properly it also leads to *Akalajajara*.

Due to the above mention causes the vitiation or disturbance in the equilibrium of *Tridosha* takes place that may lead to the genesis of following effects on the body -

- Changes in the normal constituents of the *Rasarakta* combination including its acid-base equilibrium.
- Degeneration of musculature.
- Defective functioning of the *Sandhis* - implying that the function of *Sleshaka Kapha* are affected both uniting *Jeevaparmanu* and maintaining the integrity of the bony joints.
- Mobilization of the fat deposits.
- Deficient filling of bones with marrow - implying the deficient function of bone marrow.

- Deficient production of *Shukra*.
- Reduction in the quantity of *Ojus*- Particularly the *Apara*, thereby leading to the deficient *Vyadhikshamitva shakti* (Immunity).

Different Theories Against Ageing Process

In contemporary medicine, many theories have been proposed to explain the process of ageing but neither of them appears to be fully satisfactory^[46] and most of those theories can be divided in two groups -

1. Programmed theories
2. Epigenetic or Damage or error theories

1. The Programmed Theories -The ageing is the result of a purposeful program driven by genes and follows a biological timetable like continuation and regulation of childhood, growth and development. This regulation would depend on changes in gene expression that affect the systems responsible for maintenance, repair and defense responses. The programmed theory has three sub-categories:

- **Programmed Longevity** - Ageing is the result of a sequential switching on and off of certain genes, with senescence being defined as the time when age-associated deficits are manifested. Dr. Davidovic et. al discuss the role of genetic instability in ageing and dynamics of the ageing process^[47].

- **Endocrine Theory**- Biological clocks act through hormones to control the pace of ageing. Recent studies confirm that ageing is hormonally regulated^[48].

- **Immunological Theory**-The immune system is programmed to decline over time, there is an increased risk of infectious disease and thus ageing and death. It is well documented that the effectiveness of the immune system peaks at puberty and gradually declines thereafter with advance in age. In fact, the increased death rate found in aged populations is due to great proportion of infectious processes^[49].

2. The Epigenetic or damage or error theories -

These theories emphasize environmental assaults to living organisms that induce cumulative damage at various levels as the cause of ageing. The ageing process which appears after reproductive maturation is driven by random events not genetically programmed^[50]. The damage or error theory includes

- **Wear and tear theory**- This theory was first introduced by Dr. August Weismann, a German biologist, in 1882. It is very logical because it is what happens to the nonliving things that people observe around them, like components of an ageing car break due to repeated use in the same way cells and tissues have vital parts that wear out resulting in ageing in living things.

- **Rate of living theory-** According to this theory the duration of life of an organism is dependent upon the exhaustion of a fixed quantity of a vital substance at a rate proportional to the metabolic rate^[51]. For example, rodents have a relatively fast metabolic rate compared to humans. Humans typically live much longer than rodents. This theory have argued that as an organism's metabolic rate increases, so does the production of damaging free radicals, which are known for breaking down cells over time. This, in turn, is what contributes to the ageing of an organism and a shorter lifespan in species with faster metabolic rates.
- **Cross-linking theory:** In 1942, Johan Bjorksten proposed the cross-linking theory of ageing^[52]. It suggests that an accumulation of cross-linked proteins damages cells and tissues, slowing down bodily processes resulting in ageing. Recent studies show that cross-linking reactions are involved in the age related changes in the studied proteins ^[53]. According to this theory it is the binding of glucose (simple sugars) to protein, (a process that occurs under the presence of oxygen) that causes various problems that are known as cross-linking disorders include senile cataract and the appearance of tough, leathery and yellow skin.
- **Free radicals theory:** The term free radical describes any molecule that has a free electron, and this property makes it react with healthy molecules in a destructive way. This now very famous theory of ageing was developed by Denham Harman^[54]. It proposes that superoxide and other free radicals cause damage to the macromolecular components of the cell, giving rise to accumulated damage causing cells, and eventually organs, to stop functioning. The macromolecules such as nucleic acids, lipids, sugars, and proteins are susceptible to free radical attack. It is known that diet, lifestyle, drugs (e.g. tobacco and alcohol) and radiation etc., are all accelerators of free radical production within the body.
- **Somatic DNA damage theory -** This theory posits that DNA damages occur continuously in cells of living organisms. While most of these damages are repaired, some accumulate, as the DNA Polymerases and other repair mechanisms cannot correct defects as fast as they are apparently produced. In particular, there is evidence for DNA damage accumulation in non-dividing cells of mammals. Accumulation of DNA damage and mutations eventually erodes away the genetic information that maintains homeostasis of the somatic cell population, thus leading to ageing and

age-associated pathologies such as cancer, neurodegenerative diseases including Parkinson's disease and Alzheimer's disease^[55].

- **Stress Theory:** This theory postulates that body and cell tolerate a certain amount of stress. So constant level of stress affects the rate of cell division/hormone level and many other functions.

Discussion and Conclusion

The life science of Ayurveda explains that ageing is a natural physiological process which is characterized by a gradual weakening of vital function, a lowering in the activity of metabolic process etc. People become old at different times and ageing is not necessarily accompanied by disease. Many people get old age in full possession of their physical and mental faculties. This is normal old age and man can easily reconcile himself to its inevitability. There are many factors which take place in ageing process. The primary factors of ageing are genetic and these are unavoidable. Genetically, one has a predetermined life span, morphological and physiological constitution and therefore an average rate of metabolism characteristic of a given individual. The secondary causes are avoidable and they comprise of deficiencies of various nutrients, vitamins, enzymes, hormones, infectious diseases and other vital factors. When these occur, they can and do accelerate and aggravate the ageing process.

A large number of theories for human ageing process exist, while none of them has been established as the sole mechanism of ageing. Such theories however, help in understanding the possible sequences of events that eventually in cellular senescence and finally the death. Among the prominent theories in the context are intrinsic (developmental-genetic) and extrinsic (stochastic) cause theories. The former hypothesize intrinsic, preprogrammed, genetic control of cellular senescence whereas the later suggests the cumulative cellular damage from free radicals and radiation, error in protein synthesis, and protein cross - linking as the causal mechanism for cell ageing. Ayurveda recognizes both the intrinsic and extrinsic causes of senescence. It consider that a genetically programmed mechanism of ageing by believing in decadal reduction of functional efficiency of tissue as present in table (No.2), present a precise account of this decadal decline of biological functionality of various body tissues by presuming 100 years as the average life span^[56]. Ayurveda believes that exposure to *Vata* predominant food and life style leads to an early ageing, possibly due to damage to cell because of free radicals, oxidative and radiation stresses, and poor nutrition^[57]. At the same time, Ayurveda also considers that differential rates of ageing of different tissues are now well known so

that at a given point of time in life of individual, some tissue may correspond to the chronological age, while others may be biologically older because of faster ageing^[58]. Both exogenous and endogenous factors can be observed in ageing which support the idea that there is not a single factor causing ageing but that multiple connected processes contribute to it, and it is their balance which determinates the development of ageing in the individual.

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