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Research on the Anti-aging Effect of Golden Rejuvenating Hormone Containing PQQ, Spermidine, Ergothioneine, Cycloastragalol and Cordycepin

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Abstract: *Objective:* To study the effect of Golden Rejuvenation Hormone on consumers' anti-aging. Method: Sixty test subjects from October to December 2024 were selected as the research subjects. They took one bottle of AGEVIVE Rejuvenation Drink before going to bed every day. Through consumer experience tests, anti-aging efficacy tests, etc., the sensory experience and skin test conditions of the test subjects were regularly detected, and the retention test values of the test subjects were statistically analyzed. Result: By taking Golden Rejuvenation Hormone containing PQQ, spermidine, ergothioneine, cycloastragalol cordycepin, the telomere length of the test subjects could be effectively maintained, cell vitality could be delayed, and the quality of life of the test subjects could be improved at the same time. The anti-aging effect was significant ($P < 0.05$). *Conclusion:* The golden rejuvenation hormone containing PQQ, spermidine, ergothioneine, cycloastragalol, and cordycepin, which can prolong telomeres, can present a good anti-aging effect. Based on various excellent components, it is conducive to restoring human mitochondria, promoting cell autophagy and repair, and has strong application and promotion value.

Keywords: Pyrroloquinoline quinone; Spermidine; Ergothioneine; Cycloastragalus alcohol; Cordycepin; Telomere

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1. Introduction

With the development of modern society and the intensification of population aging, anti-aging has become a research hotspot in the field of biomedicine, better meeting the current needs of consumers. Telomeres, as protective structures at the ends of chromosomes, gradually shorten in length as cells divide. Once they reach a critical length, cells will enter states such as senescence and apoptosis, and they are one of the cellular bases of human aging. The Golden Rejuvenation Essence is rich in natural components such as PQQ (pyrroquinolinone), spermidine, ergothioneine, cycloastragalone, and cordycepin. Through a synergistic effect, it can effectively extend the telomeres in the human body, thereby delaying the aging process and achieving anti-aging effects. This article aims to study the specific application effects of Golden Rejuvenation Extract, explore the influence mechanisms of various components within it, provide new ideas for research in the field of anti-aging, and promote the innovative development of anti-aging products. The report is as follows.

2. Data and methods

2.1. General information

Sixty test subjects from October to December 2024 were selected as the research subjects. The ratio of female to male was 4:1. The age of the test subjects ranged from 30 to 60 years old, with an average age of (43.67 ± 6.85) years old. 25% had normal skin, 30% had combination skin, 20% had oily skin, 15% had dry skin, and 10% had sensitive skin. The general data of the test subjects had no statistical significance ($P > 0.05$), so the contents of the subsequent studies were comparable.

2.2. Methods

The test subjects should take one vial of AGEVIVE Rejuvenation Drink 30 minutes before going to bed every night. The tests should be conducted on the 1st, 7th, 2nd, 4th, 6th and 8th weeks to analyze the application effect of the Golden Rejuvenation Essence.

2.3. Observation indicators

Develop a consumer sensory experience test. Through questionnaire surveys, collect the test subjects' feelings about the use of AGEVIVE Rejuvenation Drink. The test items include skin anti-aging, improvement of sleep quality, defecation, increase of energy, increase of appetite, increase of skin moisture, whitening, etc. The evaluation indicators include very obvious, relatively obvious, slight improvement, no improvement, deterioration, etc. Only the first three benign indicators were included in the study.

Anti-aging efficacy skin tests were conducted on the test subjects. The detection indicators included the water content of the stratum corneum, skin gloss, brightness of the cheek skin, brightness of pigmentation spots, ITA value of the cheek skin, ITA value of pigmentation spots, smoothness of wrinkles, and roughness of wrinkles etc.

2.4. Statistical methods

Data analysis was performed using SPSS 21.0 statistical software. Quantitative data were expressed as mean ± standard deviation (SD), and qualitative data were expressed as percentage (%). The 2-test was used for comparison between groups. When $P < 0.05$, it indicates that the data difference was statistically significant.

3. Result

3.1. Sensory experience test results

As can be seen from **Table 1** below, compared with the 1st and 7th days, each efficacy indicator has significantly improved. Moreover, except for the whitening item, the positive evaluation of each other efficacy exceeds 90%, indicating that the test subjects have a good sensory experience.

3.2. Anti-aging efficacy test results

As can be seen from **Table 2** below, after using the AGEVIVE Rejuvenation Drink, the water content of the stratum corneum, gloss, brightness of the cheek skin, brightness of pigmentation spots, ITA value of the cheek skin, and ITA value of pigmentation spots of the test subjects at the 4th and 8th weeks all significantly increased, and the data differences were statistically significant ($P < 0.05$). After using AGEVIVE Rejuvenation Drink, the smoothness of skin wrinkles in the test subjects improved significantly ($P < 0.05$) after the 4th and 8th weeks. The roughness of wrinkles improved to some extent in the 4th week, but not significantly. It was not until the 8th week that a significant improvement was shown ($P < 0.05$).

2.3. Telomere length

As shown in **Table 3** below, based on the comparison of the absolute values of telomere length before and after the test for

Table 1. Test results of the testers' sensory experience

Project	Day 1	Day 7	Week 2	Week 4	Week 6	Week 8
Skin anti-aging	0	28.33%	71.67%	86.67%	88.33%	91.67%
Improved sleep quality	51.67%	85%	90%	95%	96.67%	96.67%
Defecation	23.33%	81.67%	85%	91.67%	90%	95%
Boost energy	48.33%	88.33%	90%	88.33%	91.67%	90%
Increased appetite	0	65%	76.67%	71.67%	81.67%	91.67%
Increase skin moisture	16.67%	81.67%	91.67%	88.33%	93.33%	98.33%
Whitening	0	36.67%	51.67%	75%	81.67%	78.33%

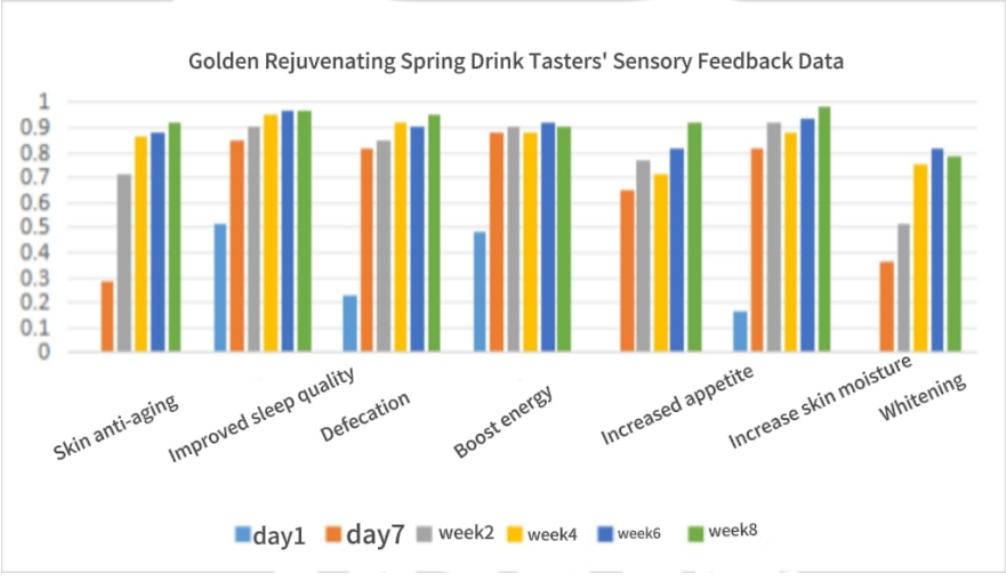

Figure 1. Golden rejuvenating spring drink tasters' sensory feedback data.

Table 2. Test results of the anti-aging efficacy of the test subjects

Indicator	Day 1	Week 4	Week 8
The water content of the stratum corneum	36.28 ± 2.49	44.93 ± 2.45**	49.65 ± 2.44**
Skin luster	5.87 ± 0.29	6.77 ± 0.37**	7.43 ± 0.36**
Cheek skin brightness	58.67 ± 0.85	59.91 ± 0.80*	61.78 ± 0.79**
The brightness of the color spot	57.57 ± 1.05	58.64 ± 1.02*	59.99 ± 1.00**
The ITA values of cheek skin	26.89 ± 2.16	29.76 ± 1.15**	34.79 ± 2.03**
The ITA values of the pigmentation spots	22.50 ± 2.68	24.41 ± 1.57*	27.39 ± 2.13**
Wrinkle smoothness	2.21 ± 0.48	1.89 ± 0.38*	1.65 ± 0.35**
Wrinkle roughness	39.38 ± 7.94	37.15 ± 6.01	35.44 ± 5.08*

Note: Compared with the first day, *$P < 0.05$, **$P < 0.005$

Table 3. Telomere test data table before and after the test

Number	Test the front-end particle length (bp)	Ranking of the same age group	Test the telomere length for 3 months (bp)	Ranking of the same age group
1	5554	66%	5613	75%*
2	5907	81%	5989	85%*
3	7076	84%	7023	79%
4	7488	76%	7566	81%*
5	7194	75%	7158	74%
6	6747	64%	6815	70%*
7	8751	72%	8824	78%*
8	8343	63%	8379	65%*
9	7016	71%	6971	66%
10	6094	77%	6154	82%*
11	8329	78%	8347	79%*
12	6132	62%	6048	58%
13	5880	69%	5917	71%*
14	8134	75%	8169	78%*
15	7755	59%	7694	54%
16	7529	69%	7570	72%*
17	5700	58%	5753	65%*
18	6763	61%	6700	55%
19	7956	87%	8026	95%*
20	7037	76%	6988	71%
21	8685	89%	8730	93%*
22	8145	85%	8180	89%*
23	8359	81%	8430	88%*
24	6759	77%	6692	68%
25	7977	79%	8008	83%*
26	5977	67%	6014	72%*
27	7513	78%	7554	83%*
28	8379	73%	8460	82%*
29	8816	91%	8867	94%*
30	5901	67%	5840	60%
31	6798	79%	6749	73%

Note: Compared with the first day, $^{*}P < 0.05$

the 31 test subjects, 67.74% of the test subjects saw an increase in telomere length after using AGEVIVE Rejuvenation Drink. Among the same age group, the rate of telomere length exceeding was significantly increased, indicating that Golden Rejuvenation Extract has a promoting effect on telomere length in the human body. And the data differences were statistically significant ($P < 0.05$).

3. Discussion

As a cofactor of REDOX enzymes, PQQ will directly affect mitochondrial biosynthesis and functional maintenance, and thereby influence the rate of telomere decay. From the molecular level, the natural component PQQ is conducive to activating peroxisome proliferators, which in turn activate PGC-1α (receptor γ coactivator), affecting mitochondrial biosynthesis [1]. The activated PGC-1α interacts with nuclear respiratory factors such as NRF1 and NRF2, promoting the expression of TFAM (mitochondrial transcription factor A), facilitating the combination of TFAM with mtDNA (mitochondrial DNA) to form a certain regulatory region, thereby driving the replication and transcription of mtDNA and achieving an increase in the number of mitochondria. Meanwhile, PQQ is also beneficial for increasing the frequency of the mitochondrial respiratory chain, thereby enhancing the ATP generation capacity of cells, providing sufficient energy for cell metabolism, and delaying the rate of cell attenuation [2]. At the antioxidant defense level, PQQ can activate the NRf2-ARE signaling pathway, induce the expression of antioxidant enzymes within cells, simultaneously disrupt the binding of Nrf2 and Keap1, accelerate the transcription of antioxidant enzymes, further enhance the cell's ability to clear reactive oxygen species such as silver superoxide ions, maintain the stability of the intracellular environment, and play a certain role in anti-aging.

Pyrroloquinoline quinone (PQQ) is naturally found in some foods and is available as a dietary supplement in its disodium crystal form. The potential health benefits of PQQ have been studied, considering its antioxidant and anti-inflammatory properties. Furthermore,PQQ has been demonstrated to significantly influence the functions of mitochondria, the organelles responsible for energy production within cells, and their dysfunction is associated with various health conditions, including obesity complications [3].

The anti-aging effect of spermidine is reflected in inducing autophagy and regulating senescence-related signaling pathways. Autophagy, as a mechanism for teaching cells to degrade and recycle, with the help of spermidine, is conducive to activating autophagy-related protein complexes, initiating the autophagy process, and promoting the nucleation and extension of autophagosome membranes [4]. In addition, spermidine can further inhibit the activity of mTORC1 (mammalian target of rapamycin complex 1), relieve the inhibitory effect of this complex on the autophagy initiation protein ULK1, thereby accelerating the occurrence of autophagy. During the process of autophagy in cells, damaged organelles, such as mitochondria and misfolded protein aggregates, are encapsulated to form autophagosomes [5]. After combining with lysosomes, autophagolysosomes are formed, thereby maintaining the stability of the intracellular environment [6]. In the regulation of aging signals, spermidine can down-regulate the expression of aging-related proteins, such as p53, p16INK4a, etc. Among them, p53, as a key regulatory protein of the cell cycle, will accelerate cell aging when overly activated. Spermidine can effectively reduce the transcriptional activity of p53 and decrease the expression of downstream aging-related genes by inhibiting the acetylation modification of p53, presenting a certain anti-aging effect. As an inhibitor of CDK (cyclin-dependent kinase), p16INK4a inhibits the binding of CDK4/6 to cyclin D, leading to cell cycle arrest and accelerating its decline [7]. Spermidine, based on the epigenetic regulatory mechanism, can effectively reduce the methylation level of the p16INK4a gene and decrease its expression, thereby enhancing the cell proliferation ability. Achieve the purpose of anti-aging.

Ergothioneine has a unique chemical structure and exhibits superior antioxidant and metal chelating capabilities. It can be specifically transported into cells by OCTN2 (organic cation transporter 2) and achieve high-concentration aggregation of ergothioneine in mitochondria through its active transport function [8]. As the key site for ROS production within cells, the enrichment of ergothioneine in mitochondria can efficiently eliminate ROS produced by the mitochondrial

respiratory chain, such as superoxide silver ions, and further inhibit lipid peroxidation of the mitochondrial membrane, thereby ensuring the integrity of the mitochondrial membrane. In addition, ergothioneine, based on its own imidazole structure, can directly react with ROS, promote ROS reduction, and continuously exert antioxidant effects through the action of the cellular reduction system [9]. In addition to direct antioxidation, ergothionein can also reduce the generation of extracellular ROS by regulating the activity of NADPH oxidase (NOX). NOX is an important source of extracellular ROS. Under stimuli such as inflammation, NOX is activated, generating a large amount of ROS and triggering oxidative stress [10]. Ergothiocyanine can inhibit the expression and assembly of NOX subunits, reduce the activity of NOX, and decrease the generation of ROS. Meanwhile, ergothioneine has a high affinity for transition metal ions such as Fe2+ and Cu2+, which can chelate these metal ions, block the Fenton reaction, prevent the generation of hydroxyl radicals, and protect intracellular biological macromolecules from oxidative damage [11]. In addition, ergothioneine can also regulate the opening of mitochondrial permeability transition pores (mPTP). Abnormal opening of mPTP can lead to the collapse of mitochondrial membrane potential, the release of cytochrome C, and trigger apoptosis. Ergothionein delays cellular senescence by maintaining the closed state of mPTP, keeping the mitochondrial membrane potential stable, and reducing the occurrence of apoptosis [12].

The anti-aging effect of cycloastragalol is mainly reflected in the regulation of telomerase activity and the maintenance of chromosomal stability. Telomeres are repetitive DNA sequences at the ends of chromosomes. As cells divide, they keep shortening [13]. When telomeres shorten to a certain extent, cells will enter a state of senescence or apoptosis. Telomerase is a reverse transcriptase capable of prolonging telomere length, consisting of an RNA component (hTR) and a catalytic subunit (hTERT). Cycloastragalol can bind to the specific stem-ring structure of hTR, stabilize the structure of the total telomerase enzyme, and enhance the activity of hTERT. hTERT uses hTR as a template and adds the TTAGGG repeat sequence to the ends of chromosomes, thereby prolonging telomere length. Studies have shown that cycloastragalenol can further promote the assembly and activity of telomerase by regulating the expression and localization of telomerase-related proteins [14]. In addition to activating telomerase, cycloastragalol is also involved in the process of DNA damage repair in cells and maintains the stability of chromosomes. When telomeres are damaged, cells will activate DNA damage repair mechanisms, such as the ATM/ATR-CHK1/2 signaling pathway. Cycloastragalenol can activate the ATM/ATR-CHK1/2 signaling pathway, promote the phosphorylation of γ-H2AX (a biomarker of DNA double-strand breaks) and the recruitment of repair proteins such as BRCA1 and Rad51, and accelerate the repair of DNA damage. Meanwhile, cycloastragalol can also regulate the expression and activity of telomere-binding proteins, such as TRF1 (telomere repeat binding factor 1) and TRF2 (telomere repeat binding factor 2). TRF1 and TRF2 can bind to telomere DNA, protect the telomere structure, prevent telomere terminal fusion and degradation, and maintain the integrity of chromosomes. Thereby delays the aging process of cells caused by telomere shortening and damage.

Cordycepin can achieve multi-target intervention in cellular senescence by interfering with nucleic acid metabolism and regulating signal pathways, etc. Its chemical structure is similar to that of adenosine. It can effectively inhibit the activity of ADK (adenosine kinase), increase the intracellular adenosine level, change the AMP/ATP ratio, and thereby activate the AMPK signaling pathway. As a cellular energy receptor, AMPK, once activated, can phosphorylate downstream target proteins, effectively regulate cellular metabolic processes, accelerate fatty acid oxidation, glucose uptake, and autophagy, thereby improving the cellular energy metabolism state and enhancing the anti-aging effect of Golden rejuvenation hormone. In terms of regulating gene expression, cordycepin can also regulate the expression of genes related to aging, such as down-regulating CDKN2A, IL6, etc., while up-regulating the expression of anti-aging genes, such as SIRT1, FOXO1, etc., achieving certain anti-aging effects. In addition, cordycepin can also affect the activity of gene transcription factors and their binding sites, adjust the level of gene transcription, and thereby regulate the process of cellular senescence [15]. For instance, cordycepin can achieve efficient regulation of inflammation by inhibiting the activation of the NF-κB signaling pathway, preventing the phosphorylation and degradation of IκB, and reducing the release of pro-inflammatory factors. This is beneficial for alleviating the inflammatory response in the human body, avoiding accelerated cell aging, and slowing down the aging process.

In the Golden Rejuvenation Essence, these five natural ingredients do not act independently but work together to achieve the goal of anti-aging. PQQ and ergothioneine can effectively protect mitochondrial function from different perspectives. For instance, PQQ promotes mitochondrial biosynthesis and further enhances their energy metabolism, while ergothioneine strengthens the peroxidation protection of mitochondria, thereby reducing oxidative damage to cells, providing them with a stable and sufficient energy supply, further prolonging cell telomeres, and demonstrating anti-aging effects. Spermidine and cordycepin can both regulate autophagy and its inflammatory response in cells, effectively remove intracellular waste, create favorable conditions for the autophagy process, and synergically control aging-related signaling pathways to reduce the expression of aging-related proteins. Cycloastragalol further enhances chromosomal stability by lengthening telomeres, promotes continuous cell proliferation, and facilitates the function of telomerase. Under the combined effect of other components, it achieves a comprehensive delay in cell aging and drives continuous innovation in the field of anti-aging.

In conclusion, the Golden Rejuvenating Extract, by integrating natural components such as PQQ, spermidine, ergothioneine, cycloastragalol, and cordycepin, can effectively extend telomeres, regulate aging-related signaling pathways and gene expression, and up-regulate the expression of anti-aging genes, thereby demonstrating excellent anti-aging application effects. At the theoretical level, it will reveal the molecular mechanism by which multiple natural active ingredients cooperatively regulate telomeres, enriching the biological theory of aging. At the application level, if the research is successful, Golden Rejuvenation is expected to become a safe and efficient anti-aging product, providing new strategies for the prevention and treatment of aging-related diseases such as cardiovascular diseases and neurodegenerative diseases. At the same time, it can also improve the quality of life of the elderly and reduce the medical burden on society, with broad market prospects and social benefits.

4. Conclusion

The application of Golden Rejuvenation Extract can not only increase the number of telomeres in the human body but also improve the quality of life of users. Its anti-aging effect is relatively significant and it has strong application value.

Disclosure statement

The author declares no conflict of interest.

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