Title : JELLYMEMORY-STRONG BİTE

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INTRODUCTİON

Abstract

Alzheimer's disease is a common neurodegenerative disease characterized by impairment of cognitive functions and memory loss. Patients experience nutritional difficulties due to problems such as water and electrolyte imbalance. This project aims to develop an innovative jelly bean formulation to meet the water and electrolyte needs of Alzheimer's patients. Jelly beans are designed to both encourage fluid intake and maintain electrolyte balance. These products, prepared with natural ingredients, aim to increase patient compliance with taste and ease of use.

During the project, the physiological and cognitive effects of electrolyte imbalance were examined and the potential benefits of the developed jelly beans were evaluated. Jelly beans with optimized electrolyte content and water rate, offer a practical solution to improve the quality of life of Alzheimer's patients. In addition, the nutritional values of the materials used were analyzed to reveal the positive effects of the product on health.

In conclusion, this project enabled the development of a supportive product to meet the daily hydration and nutritional needs of Alzheimer's patients. By evaluating the effectiveness and safety of the product through human trials, it is aimed to make significant contributions both scientifically and socially.

Keywords: Alzheimer, water, electrolyte, jellybean, nutrition

1. What is Alzheimer's disease?

A female patient named Auguste D. was admitted to a psychiatric hospital in 1901 due to complaints that developed over a short period of time (paranoia, aggressiveness, memory and sleep problems, crying spells). The patient, who was cared for by Alois Alzheimer, gradually got worse and died within 5 years. At the congress in Tübingen, he presented the extraordinary findings resulting from the autopsy under the title "On a unique disease of the cerebral cortex". However, he did not receive much attention from his colleagues and continued his studies with similar cases. Alois Alzheimer Dr. Kraepelin was the first psychiatrist to use the term Alzheimer's disease in his book in 1908. Blennow, K., De Leon, M. J., Zetterberg, H. (2006). The disease is characterized by pathophysiological changes such as neuron loss, synaptic dysfunction and beta-amyloid plaque accumulation in the brain tissue (Hardy & Selkoe, 2002)

Alzheimer's disease was first defined by Dr. Alois Alzheimer in 1906 by examining the patient's brain. Since then, many studies have been conducted on the symptoms and effects of the disease, and its definition has been constantly updated. Gilman S. Alzheimer's disease.

(1997); Lleó Annu Rev Med (2006) Alzheimer's disease (AD); is a progressive neurodegenerative disease characterized by decreased cognitive functions, self-care deficits, and various neuropsychiatric and behavioral disorders, resulting from neuron and synapse losses in various parts of the central nervous system (CNS).

The history of the disease provides an important insight into how the scientific community's understanding of the disease has evolved. Alzheimer's disease accounts for 60%–70% of dementia cases worldwide and is becoming more prevalent as the elderly population increases (Ballard et al., 2011).

Alzheimer's disease is a neurodegenerative condition, usually seen in the elderly population, characterized by memory loss, cognitive disorders and behavioral changes, and is a neurological disorder that causes brain cells to die over time. This disease leads to cognitive dysfunction, memory loss and personality changes. The causes, symptoms, diagnostic methods, treatment methods and prevention of this disease, which has become a growing source of concern today, need to be examined in detail. The human body needs the right balance of electrolytes and water to function healthily. This balance is vital for the proper functioning of chemical and electrical processes in the body. Electrolytes and water work together in the body to regulate cell functions and help control body temperature. This balance is critical for human health, and achieving this balance ensures that various systems in the body function compatibly. This is of critical importance for individuals who have difficulty regulating nutrition, water and electrolyte levels due to Alzheimer's disease, as patients often forget or unconsciously reduce their water consumption.

1.1. The Diagnose of Alzheimer

The diagnosis of Alzheimer's disease begins with a comprehensive assessment based on the patient's story and symptoms. During this process, a series of tests and procedures are applied to examine the patient's cognitive functions and behavioral status. Traditional diagnostic approaches include neurological examination, cognitive tests, imaging methods, and laboratory analyses.

1.1.1 Neurological Examination: The examination is a fundamental step in diagnosing Alzheimer's disease. During this examination, the brain and nervous system are examined in a general way. Factors such as general health status, muscle strength, reflexes, balance, coordination, speech and auditory characteristics. At the same time, mental abilities such as theoretical characteristics, memory and problem solving are tested. Neurological examinations play a critical role in studying Alzheimer's symptoms and other disease disorders from an external perspective.

1.1.2 Cognitive Tests: Cognitive tests are an important tool for detecting early signs of the disease. These tests measure memory, attention, language use, problem-solving abilities, and other mental functions. Standardized tests such as the Mini Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) are often used to identify signs of Alzheimer's.

1.1.3 Imaging Methods: Advanced imaging techniques are used to support the diagnosis of the disease.

a) Magnetic Resonance Imaging (MRI): An MRI uses magnetic fields and radio waves to create detailed images of brain structures. MRI can detect shrinkage in areas of the brain that are responsible for memory, such as the hippocampus. It can also evaluate other abnormalities or bleeding in the brain.

b) Computed Tomography (CT): CT scans provide cross-sectional images of the brain using X-rays. CT can be used to look at structural changes and damage to the brain and detect brain shrinkage that occurs in the later stages of Alzheimer's disease.

1.1.4 Laboratory Tests:

Laboratory tests are used to rule out other medical conditions that may mimic Alzheimer's disease. Blood tests can evaluate factors such as thyroid function, vitamin deficiencies, or infections. Analysis of biomarkers such as beta-amyloid and tau protein levels in samples of cerebrospinal fluid is helpful in confirming the presence or progression of the disease.

1.1.5 Innovative Methods:

In recent years, biomarkers and sensitive imaging methods have been on spotlight in the diagnosis of Alzheimer's disease.

1.1.6 Biomarkers:

Molecular markers that can be measured in blood, urine or cerebrospinal fluid make it possible to diagnose Alzheimer's disease more precisely. In particular, beta-amyloid and tau proteins play an important role in early diagnosis and monitoring of the disease's progression.

1.1.7 Positron Emission Tomography(PET):

PET scans reveal biological traces of Alzheimer's by examining metabolic activities and beta-amyloid buildup in the brain.

1.2 Alzheimer's Disease Treatment Methods

Methods used in the treatment of Alzheimer's disease include traditional and innovative approaches. While traditional methods aim to alleviate symptoms and slow the progression of the disease, innovative methods aim to address the root causes of the disease.

a) Traditional Treatment Methods

The most common traditional treatment for Alzheimer's is medicine therapy. This treatment is used to relieve symptoms and improve the patient's quality of life.

- **Cholinesterase Inhibitors:** Provides temporary improvements in memory and cognitive

functions by increasing the level of acetylcholine in the brain. Donepezil, rivastigmine and galantamine can be given as examples of medicine in this group.

- **NMDA Receptor Antagonists:** Helps protect nerve cells by regulating excess glutamate activity in the brain. Memantine is a commonly used medicine in this group.

However, these medications cannot stop the disease from progressing; they only relieve the symptoms. During the treatment process, the side effects of the drugs and the individual needs of each patient should be carefully considered.

b) Innovative Treatment Methods

Innovative methods to fight against Alzheimer's disease focus on the biological mechanisms of the disease and aim to provide more effective solutions in the future.

- **Gene Therapy:** It aims to slow down the progress of the disease by targeting genetic mutations.
- **İmmunotherapy:** It aims to reduce beta-amyloid accumulation in the brain by strengthening the immune system.
- **Cognitive Rehabilitation:** It includes therapy methods aimed at preserving and improving patients' cognitive skills.
- **Cellular Therapies:** Supports brain functions by regenerating nerve cells through methods such as stem cell therapy, neurogenesis and cell transplantation.

c) Herbal Treatment Approaches

Herbal treatments play a supporting role in alleviating Alzheimer's symptoms. Herbal products such as ginkgo biloba, turmeric, and juniper berry are thought to benefit cognitive functions due to their antioxidant and anti-inflammatory properties. However, more scientific research is needed on the effectiveness and safety of these approaches.

1.3 Causes of Alzheimer's disease

Although the causes of Alzheimer's disease are not fully known, a combination of genetic and environmental factors play an important role in the development of the disease. Among genetic factors, the APOE (apolipoprotein E) gene stands out; it is known that the APOE4 allele increases the risk of the disease. In addition, mutations in genes such as APP (amyloid precursor protein), PSEN1 (presenilin 1) and PSEN2 (presenilin 2) are associated with early-onset Alzheimer's cases. Environmental factors include advanced age, low education level, head trauma, cardiovascular diseases, diabetes, stress, insufficient cognitive and physical activity, and unhealthy eating habits. In particular, regular exercise, cognitive activities, and social interactions have been shown to reduce the risk of the disease. Therefore, healthy lifestyle changes, as well as genetic predisposition, play an important role in the prevention of Alzheimer's disease.

1.4. Symptoms of Alzheimer's Disease

Alzheimer's disease shows itself with cognitive and behavioral changes. Cognitive symptoms include memory loss, difficulty concentrating and making decisions, decreased language skills, and getting lost in familiar places. Alzheimer's disease usually begins with memory loss and cognitive

decline. In the later stages of the disease, getting lost in familiar places, poor language skills, and impaired motor skills are seen (McKhann et al., 2011). In addition, behavioral disorders such as irritability, depression, and hallucinations are also common symptoms (Morris, 1993). Behavioral and psychological symptoms include irritability, fear, depression, hallucinations, aggression, paranoia, and excessive suspiciousness. These symptoms intensify as the disease progresses, make daily life difficult, and seriously affect the quality of life of both the patient and their caregivers.

The etiology of the disease can be explained by the complex interaction of genetic, environmental and biological factors. The APOE4 allele is the most important genetic factor that increases the risk of the disease (Yu, Tan & Hardy, 2014). In addition, beta-amyloid accumulation and tau protein hyperphosphorylation have been identified as the main biological mechanisms leading to neuronal death (Ittner & Götz, 2011).

1.5 Treatment of Alzheimer

Treatment for Alzheimer's disease involves a combination of different methods to control symptoms, slow the progression of the disease, and improve the patient's quality of life:

a) Medicine Treatment

Medicine Used: Cholinesterase inhibitors and NMDA receptor antagonists.

Purpose: Increasing nerve cell communication by regulating neurotransmitter levels.

Feature: Treatment is planned specifically for the individual.

b) Behavioral and Psychosocial Treatments

Purpose: To support cognitive functions, increase independence in daily living, and reduce emotional problems (e.g. anxiety, depression).
Methods: Cognitive therapy, emotional support, motor skills training, activity planning.
c) Other Treatment Methods

Alternative Methods: Nutritional support, physical exercise, art and music therapy. Status: More research is needed on their effectiveness.

Status: More research is needed on their effectiveness.

1.6 Nutrition in Alzheimer

In Alzheimer's disease, nutrition plays a critical role in slowing the progression of the disease and managing symptoms; especially nutrients such as antioxidants, omega-3 fatty acids, and B vitamins support brain health and may reduce the risk of the disease. It has been observed that nutrition is closely related to the pathophysiology of Alzheimer's disease. Nutrition is indicated as an important non-pharmacological preventive factor for AD. According to the results of a large-scale meta-analysis, the most modifiable risk factors in AD are a healthy lifestyle and nutrition (Yu et al.,

2020). Current nutrition and nutrition-related risk factors for AD include high dietary fat from high-energy diets, excess meat consumption, diabetes, hyperhomocysteinemia, hypertension, and obesity (Grant and Blake, 2023; Yu et al., 2020)

Consuming foods rich in antioxidants, such as fruits, vegetables, dark-colored fruits, green leafy vegetables, and walnuts, may help alleviate the symptoms of Alzheimer's disease. Omega-3 fatty acids are one of the building blocks of brain cell membranes and may have neuroprotective effects in reducing the symptoms of Alzheimer's disease. Regular consumption of foods rich in omega-3 fatty acids, especially fish, may contribute to maintaining brain health and slowing the progression of the disease. A diet low in saturated fat, high in fiber, omega-3 fatty acids, and antioxidants supports brain health and may alleviate the symptoms of the disease. While macronutrient groups include carbohydrates, proteins, and fats, micronutrient groups consist of vitamins and minerals. Consuming these food groups in a balanced manner may have positive effects on general health and brain function. Antioxidants are substances that protect the body against oxidative stress and have the potential to protect brain cells in Alzheimer's patients. Individuals with Alzheimer's disease are at risk of malnutrition. Difficulty in eating, confusion in using utensils such as plates, decreased appetite, difficulty chewing, and other accompanying chronic diseases also cause individuals to become malnourished. In addition to these, other psychological factors accompanying AD (depression, feeling lonely, feeling abandoned, anxiety, etc.) can also worsen the current nutritional status of individuals (Martínez-Tomé et al., 2021). In addition, adequate fluid intake and regular food consumption can also increase the quality of life of Alzheimer's patients. A nutritional plan organized in this way plays an important role in protecting the general health status and brain functions of Alzheimer's patients. Healthy eating habits can positively affect the course of Alzheimer's disease and increase the quality of life of patients.

1.7 The Role of Electrolytes and Nutritional Strategies in Alzheimer's Disease

Alzheimer's disease is a growing health problem worldwide, characterized by cognitive decline, memory loss, and behavioral changes. Different methods are applied in the treatment of this disease to relieve symptoms and improve quality of life. The importance of electrolytes in Alzheimer's disease stems from their critical roles in nerve conduction, fluid balance, and cellular communication in the body. Considering that electrolyte imbalances can affect the course of this disease and contribute to treatment, maintaining electrolyte balance is of great importance for Alzheimer's patients. This report will discuss the role of electrolytes in Alzheimer's disease, the effects of electrolyte imbalance, and nutritional strategies that can be applied to maintain this balance.

1.7.1 The Definition and Importance of Electrolytes

Electrolytes are mineral salts that are found in ionic forms and are necessary for the body to maintain normal functioning. Among these, **sodium, potassium, calcium, and magnesium** are the most critical. Electrolytes perform vital functions such as maintaining cellular fluid balance, providing nerve conduction, regulating muscle contractions, and maintaining acid-base balance. It is known that Alzheimer's patients often experience dehydration and electrolyte imbalances. Given the critical role of electrolytes in maintaining brain function, the impact of these imbalances on the progression of the disease is of great importance (Kochanek & Clark, 2020). Deficiencies of electrolytes such as potassium and magnesium can cause serious setbacks in cognitive functions (Lambert & Amouyel, 2011).

a) Electrolyte's Duty

Sodium and Potassium: Play a critical role in nerve cell signal transmission and resting potential.

Calcium: Effective in many physiological processes from bone health to nerve conduction and muscle contractions.

Magnesium: Provides stability to nerve cell membranes, plays a role in energy production and nerve functions.

b) The Importance of Electrolytes in Alzheimer's Disease

Electrolytes may influence the cognitive impairments associated with Alzheimer's disease. The regulation of neurotransmission and cell signaling in the brain highlights the role of electrolytes in Alzheimer's disease. Electrolyte imbalances may contribute to cognitive impairment and disease progression.

c) Electrolyte Sources

Sodium: Sodium is found in foods such as salt and pickles. However, overconsumption can

lead to hypertension.

Potassium: Potassium is rich in foods such as bananas, avocados, spinach and potatoes.

Calsium: Dairy products, dark green leafy vegetables, and almonds are important sources.

Magnesium: It is found in legumes, seeds, and grains.

1.7.2 Effects of Electrolyte Imbalances in Alzheimer's Disease

Electrolyte imbalances can worsen symptoms of Alzheimer's disease and negatively affect brain function.

a) Effects of Low Sodium Levels
Hyponatremia (low sodium levels) can lead to mental confusion and impaired cognitive function in Alzheimer's patients.

b) Effects of Low Potassium Levels
Low potassium levels can cause muscle weakness and decreased cognitive function.

c) Effects of Calcium and Magnesium Deficiencies
Calcium deficiency affects communication between nerve cells, while magnesium deficiency can lead to imbalance of nerve cell membranes and decreased energy production.

1.7.3 Methods to Maintain Electrolyte Balance in Alzheimer's Patients

Maintaining electrolyte balance can improve the cognitive and physical status of Alzheimer's patients.

1.8 The Role of Nutrition

Proper nutrition is a key element in maintaining electrolyte balance for Alzheimer's patients. A balanced diet should provide regular intake of electrolytes such as potassium, calcium, magnesium and sodium.

1.9 Water Consumption and Electrolyte Balance

Alzheimer's patients often forget to drink water, which can lead to dehydration and electrolyte imbalance. It is important for patients to consume water regularly and add foods with high water content to their diet.

2. Use of Gummy Bears in Alzheimer's Treatment

Snacks with high water and electrolyte content, such as gummy bears, can help Alzheimer's patients meet their daily fluid and electrolyte needs.

2.1. Advantages of Gummy Bears

a) Water Content: It can support the fluid intake of Alzheimer's patients.
b) Electrolyte Content: It contributes to the maintenance of electrolyte balance by containing electrolytes such as sodium, potassium and chloride.
c) Delicious Structure: It offers an alternative that patients can easily consume and enjoy.
Method
Health and safety rules
During work and research;
1. Aprons were worn to protect against any chemical substances that would spill or break in the laboratory. A mask was used to protect against chemical substances that would be inhaled.
2. Hand hygiene was taken care of during the laboratory, gloves were used.
3. All materials used during the analyses and turned into waste were disposed of in appropriate

disposal containers.

METHOD:

1. Problem Definition

Our goal is to develop an innovative jelly bean formulation that will make it easier for Alzheimer's patients to meet their daily water and electrolyte needs. Besides encouraging patients to consume water, it will also have an equalizer effect on the electrolyte balance in the body. Our product aims to increase patients' water and electrolyte balance with its features such as taste, structure and ease of use while supporting the water and electrolyte balance of patients.The physiological and neurological effects of water and electrolyte imbalance in Alzheimer's patients have been studied in detail. Especially, the effects of this imbalance on the progression of the disease and its contribution to cognitive functions have been scientifically evaluated. In addition, the produced jellybean formulation is intended to be a solution that provides ease of use for both patients and caretakers. We aimed to contribute to the patients' quality of life and to support them in overcoming the difficulties brought by the disease. Having features that both improve hydration levels and maintain electrolyte balance shows that this study will bring an important innovation in scientific and social terms. In this project, the aim is to develop an innovative jelly bean formulation that has properties that both encourage water consumption and support electrolyte balance in order to simplify Alzheimer's patients in meeting their daily water and electrolyte requirements. In the project, the negative effects of water and electrolyte imbalance on the progression of Alzheimer's disease were examined in detail, and the benefits of jelly bean in providing this balance were evaluated scientifically and clinically. In addition, it was emphasized that this product should be optimized in terms of taste, structure and ease of use in a way that will increase patient compliance.

2. Hypothesis

The development of an innovative jelly bean formulation that promotes water consumption and supports electrolyte balance will help mitigate the negative effects of dehydration and electrolyte imbalance in Alzheimer's patients, leading to improved physiological stability, cognitive function, and patient compliance.
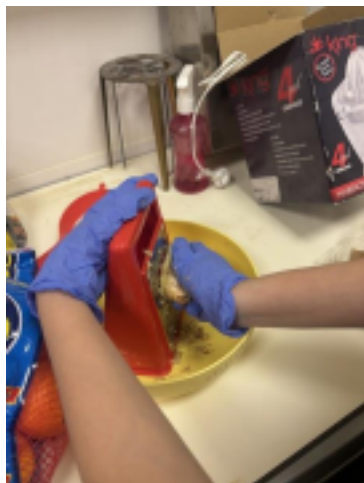
3. Ingredients:
· 1 large orange
· 2 mandarins
· 1 lemon
· Jelly seaweed
· Honey
· Ginger powder
· Turmeric
· Black pepper

·Electrolyte powder
· Blender

· Pot
· Silicone molds

Preparation: Peel the oranges, tangerines and lemons. Grate the ginger.

Picture 1. Grating the ginger

Mixing: The peeled peels were blended to obtain a smooth mixture.

Heating: The mixture that passed through the blender was put into the pot without being

filtered and brought to the boiling point

Picture 2. Mixing and heating the ingredients

Adding Jelly Seaweed: Jeally seaweedwas added to the mixture that started to boil and stirred continuously for 2 minutes.

Sweetening and Seasoning: Honey, ginger powder, turmeric and black pepper were added to the mixture and mixed until a homogeneous consistency was achieved. Electrolyte powder was also added at this stage.

Picture 3. Putting the jellybeans in silicone containers

Moulding: The prepared mixture was poured into silicone molds in equal amounts.
Cooling: The molds were kept in the refrigerator for about 1 hour to allow the jellybeans to solidify

Picture 4. Ready-to-eat jelly beans

Time / Definition of Work Packages				M AK	
1- Determining the problem and creating the project idea	X				
2-Framing the problem and establishing hypotheses	X				
3-Literature review	X	X	X		
4-Determination of the method		X			
5-Determination of data collection tool		X			
6-Application of research method			X	X	
7-Collecting and analyzing findings				X	
8-Interpretation of findings				X	
9-Writing the project report		X	X	X	X
10-Writing the project summary					X
11-Determining the project name					X

Results:

Ingredients and Nutritional Information (Approx.)

Material	Weight (g)	Calories (kcal)	Carbohydrate (g)	Protein(g)	Oil(g)	Water rate(%)	Amount of water(g)
Orange(1)	200	86	22	1,7	0,2	88	176
Tangerine(2)	140	70	18	0,9	0,2	87	121,8
Lemon(1)	65	17	5,4	0,6	0,2	87	56,6
Jelly seaweed(2)	10	30	8	0,1	0	0	0
Honey(2)	42	126	34	0,1	0	17	7,14
Ginger powder(1	2	6	1,5	0,1	0	5	0,1
Turmeric powder	2	8	1,4	0,2	0	5	0,1
Black pepper(1)	2	6	1,4	0,2	0,1	5	0,1
Electrolyte powd	15	45	11	0	0	0	0
Total	478	394	102,7	3,9	0,7	75,7	361,84

Table 1. Approximate nutritional values of the ingredients used

Total Nutritional Values (Approximate)

The total nutritional values of the prepared jelly beans are calculated as follows:

· **Calories:** 394 kcal

· **Carbohydrates:** 102.7 g

· **Protein**: 3.9 g

· **Fat:** 0.7 g

· **Sodium:** 42.9 mg (from 15 g electrolyte powder)

· **Potassium:** 22.5 mg (from 15 g electrolyte powder)

· **Calcium:** 18 mg (from 15 g electrolyte powder)

· **Magnesium:** 3.6 mg (from 15 g electrolyte powder)

Amount of Water

Material	Weight(g)	Water rate %	Amount of water (g)
Orange(1)	200	88	176
Mandarin(2)	140	87	121,8
Lemon(1)	65	87	56,6
Jelly Seaweed	10	0	0
Honey	42	17	7,14
Ginger powder	2	5	0,1
Turmeric powder	2	5	0,1
Black pepper	2	5	0,1
Elektrolyte powd	15	0	0
Total	478	-	361,84

Table 2. Water ratios of ingredients

Water Ratio (%)

Water ratio is the ratio of the total amount of water to the total weight of the recipe:

$$\text{Water Ratio} = \left(\frac{\text{Total Water Amount}}{\text{Total Weight}}\right) \times 100$$

$$\text{Water Ratio} = \left(\frac{361.84}{478}\right) \times 100 = 75.7\%$$

The jellybeans prepared in this recipe **consist of approximately 75.7% water.**

This recipe is prepared with natural fruit juices, honey and spices, so it has high nutritional value and immune-supporting properties. Compared to traditional jellybeans, it has a significant advantage of not containing refined sugar and artificial additives. Agar agar was used to replace gelatin with a herbal alternative. The addition of electrolyte powder made these jellybeans a special snack for athletes or individuals who need electrolytes. At the end of the

project, a healthy jellybean recipe was developed with natural ingredients and its nutritional values were calculated. These jellybeans offer an attractive option for both individuals who want to support their immunity and those who want to turn to products with natural content.

Results and Discussion

This study focused on calculating the nutritional values of the jellybean developed for Alzheimer's patients. Due to ethical reasons, it was not possible to test this jellybean on human trials. Therefore, the potential effects of the jellybean on Alzheimer's patients could not be directly observed. However, when the content of the jellybean is taken into account, it is predicted that the vitamins, minerals and other nutrients it contains may provide significant benefits for Alzheimer's patients. According to the calculated nutritional values, the jellybean is formulated to help meet daily nutritional requirements. Vitamin A, vitamin C, vitamin E and B vitamins stand out among the vitamins contained in the jellybean. In addition, micronutrients such as calcium, magnesium, potassium and zinc from the minerals may help support the neurological health of Alzheimer's patients. The jellybean also contains some essential nutrients that may be lacking in the diet of Alzheimer's patients. For example, omega-3 fatty acids may offer potential benefits for improving brain function.

The results of the study indicate that the jellybean may be an additional support in meeting the nutritional needs of Alzheimer's patients. However, the nutritional values obtained are only theoretical and human trials are required to draw definitive conclusions about the effectiveness of this product. Future clinical studies will make it possible to directly observe the effects of this jelly in Alzheimer's patients and provide definitive data on whether such products contribute to treatment.

Recommendations

The flavor profile of the gummy bears can be customized according to the individual preferences of the users. The flavor of the gummy bear can be enriched by using different fruit juices and natural sweeteners, thus enabling Alzheimer's patients to consume the product more willingly. In addition, it can be made suitable especially for diabetics by using low glycemic index sweeteners that will balance blood sugar.

The nutritional values of gummy bears can be examined in more detail with laboratory analyses; these analyses can help develop more suitable formulations for Alzheimer's patients by investigating the more efficient use of nutrients by the body. In addition, the electrolyte ratios contained in gummy bears can be optimized for athletes; formulations containing electrolytes such as potassium, sodium, calcium and magnesium can help prevent muscle cramps while increasing athletes' performance. These gummy bears can be formulated to contribute to rapid recovery after sports.

In addition, the formulations of gummy bears can be diversified according to age groups and health needs. For example, vitamins and minerals can be added to strengthen the immune system for older

individuals, while additional ingredients can be offered to support growth and development for children. Market research can be conducted to learn more about the product and improvements can be made based on target audience feedback. Long-term studies can allow us to better understand the effectiveness and potential side effects of this jelly on Alzheimer's patients. Such studies will provide important data to confirm the true benefits of the product and contribute to treatment.

Conclusion:

This project successfully explores the development of an innovative jelly bean formulation designed to support hydration and electrolyte balance in Alzheimer's patients. Given the critical role of water and electrolyte balance in cognitive function and overall health, this product has the potential to address a significant challenge faced by patients and caregivers.

By optimizing taste, texture, and ease of use, the formulation encourages water consumption and facilitates electrolyte regulation, improving patient compliance and quality of life. Scientific and clinical evaluations highlight the potential benefits of this approach in slowing disease progression and enhancing physiological stability.

Ultimately, this study presents a promising, practical solution that can contribute to both the scientific and social aspects of Alzheimer's care. Further research and clinical trials will be essential to validate its long-term effectiveness and integration into patient care strategies.

Resources

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