Space Food And Beverage

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Many people wonder how and what the astronauts eat, drink and consume during their space missions at the space station. Space Food and beverage are the variety of food products that are consumed by the astronauts in outer space. Many space missions are carried out to bring about different trends in space foods and beverages. Various parameters are such as the food preparation, characteristics, preservations, packaging, innovations, processed food products, and different case study aspects are taken into considerations. Space food and beverage study also include its types, innovations, challenges, and applications. This study includes the nutritional diet of the astronauts in the space station. space food and beverages also include advancement in the techniques to prolong the shelf life and to the nutritional requirements of the astronauts during the missions. Space food and beverages should be easy to prepare and easy to clean up in microgravity. Space beverages also include a study on the different requirements and the experiments on the alcoholic and the non-alcoholic and the way of their consumption in the space station. Menu selection and diet items have been tremendously evolved from the mercury mission. This study involves the actual food system in the space stations.

Keywords: Microgravity, astronauts, space stations, advancements, nutrition, menu selection.
**Introduction**

Indian space research organization (ISRO) spends year ten thousand crores to bring about food innovations in space food meanwhile the American space center (NASA) has a budget of the 22.6 billion dollars to study different innovations in space food and beverages. The very first time the food was eaten in the space was in the year 1962 where John Glenn was the first American person to eat in the space. Different missions were carried out to enhance the food and beverage innovations techniques. For the very first mission astronauts were provided with two meal packages for the five hours of mission. High-budget missions are involved to prolong the shelf life of the food and the beverage and non-alcoholic beverages have gained lots of importance in the space beverage business. A surprising amount of the alcohol has also traveled on the Russian Mir mission stations which opened the consumption of alcoholic beverages for the astronauts during the prolonged missions at the space station. It has shown trending studies about space food and the beverages include the packaging of the space food and the beverages based upon the textural analysis and their types as well. Space food and beverages include one of the complexity is Space Adaption Syndrome (space motion sickness) and it plays important role in the consumption of space food for astronauts. There is the committee of the Space Science Board that looks after the supply of the micronutrients such as the vitamins and the minerals which are required in an adequate amount. Even after the efforts of the scientists that are working continuously for the space food and beverages are unable to fulfill the nutritional parameters of the astronauts which is another big challenge of the food committee. (1) The food committee working with the innovations of space food and beverages cannot force the astronauts to test their innovations and the only for it is to make the food more palatable as well as digesting.

**Objectives**

01. To make readers aware of the space food and the beverages and their challenges.

02. To highlight the types of the food and their characteristics.

03. It provides knowledge about the factors affecting the space of food and beverages.

**Space food and its characteristics**

Space food is the variety of food products specially created, designed, and processed for the consumption of the astronauts during space missions. Space food exhibit certain characteristics which are required to study further parameters of the space food. (3)

Characteristics:

01. It must be nutritional.

02. It should be easy to digest and palatable

03. It must be low weight

04. It should be properly sealed.

05. Quick and easy to clean up.

**Space food evolution and improvement**

As NASA began sending the humans to space, there also began the search for food for the astronauts. So far the development of space food had to undergo many parameters and analysis in order to fit into the safe food categories. Different missions were carried out for the innovations of space foods and beverages, the space food did not taste good due to the decreased atmosphere as the ability of taste buds was lowered. In the year 1970-1980 culinary options included more than 70 food items at the space station (2). At first mission, mercury food was available in the form of squeezable tubes. At the Gemini mission, liquid foods such as juices and soups were introduced. Apollo mission for the very first time the packaging material was introduced. Skylab mission, the introduction of utensils were made before mission food was available in the dehydrated form. Johnson Space Center invited the astronauts for the taste-testing sessions where their opinions are taken into the account for further recommendations of the dishes. NASA has now begun the project on space gardening. (4)

**Missions for space food**

1. Mercury (1962-1964) - It was the first space program that sent humans to space. It included bite-sized cubes, freeze-dried powder and tubes of semi-liquids. This food was
Unappetizing. The texture of food products changed in the terms of organoleptic properties. Astronauts disliked the meal on this mission(2).

02. Gemini(1965-1967) - This mission was carried to bring NASA one step closer to going to the moon. In this mission dehydrated, freeze-dried, bite-sized food with oil coating was done to prevent crumbling. In this mission, there was improved quality of the food products and their packaging. This is the mission where Cocktail was introduced, and also came up with the meal combinations. (2)

3. Apollo(1968-1975) - The mission where men land on the moon. It included thermostabilized and irradiated foods. First to use hot water, then began using of the utensils such as spoon bowl system and thermo-stabilized pouch. The Apollo mission also introduced thermo-stabilized pouches called wet packs was also introduced. These wet packs were used to keep the food moist for a long period of time, before this invention astronauts used to rehydrate the food using the water. (5)

4. Skylab (1971-1973)- In this mission freezer, refrigerator, warming trays, and a table was introduced. Eating a meal on the Skylab mission was more like eating a meal at home. Food containers were introduced in this mission. The main aim of this mission was to prove that humans can live in space for a longer time to complete their missions. Skylab missions also included the introduction of 72 different food items. Skylab’s mission also included storage of frozen food products. A simple heating device was also introduced during this mission and heating took place with the mode of the conduction at the space station. (2)

Types of space food

1. Rehydrated foods - Water is removed from rehydrated foods to make them easier to store. It is also called freeze-drying. For example spiced cereals, toast. Reducing the water reduced the microbial activity in the food products. Rehydratable types of items available in space foods as well as beverages. Breakfast cereals were also made rehydratable by adding water just before their consumption. Rehydratable food was packaged in a flexible packaging material that was easily compressible. Food products are rehydrated using the hot water before consumption by the astronauts(5).

2. Intermediate moisture foods(IMF) - It was produced by restricting the amount of water available for microbial growth. Water is chemically bonded to sugar or salt. Water content is 15-20 percent. For example dried peaches, pears, and apricots.

3. Thermostabilised foods - These foods are stable at room temperature and are heat processed. Most of the fruits and fish are thermostabilised in cans. For example tomatoes, grilled chicken and ham. The food eats directly consumed using conventional utensils. Plastic cups were used for packaging the puddings, thermostability food products are available commercially in the market in the form of retort pouches. Fruits and vegetables are easily stored using thermostabilised cans. Generally, Aluminium foils or bimetallic cans are used as packaging material for the thermostabilised food product.(6)

4. Irradiated foods - Irradiated foods are those which use ionizing radiation by exposure to x-rays. Irradiated meat had higher organoleptic acceptability compared to thermally processed foods. For example, meat is irradiated at 44kGy. Beef steaks the only example of irradiated space food products. (2)

5. Frozen foods - These foods are quick-frozen forms to prevent a build-up of large ice crystals. It included quiches and chicken pot pie.

6. Fresh foods - Fresh fruits and vegetables are neither processed nor artificially preserved. They are sanitized with 200 parts per million (ppm) of chlorine rinse to ensure food safety. Vegetables like carrots and celery are packaged in the bags.

7. Natural form food-Natural food products are readily available for consumption, no further processing is required to make the food product ready. These food products are packed in flexible pouches. These food products are generally granola bars, cookies, and nuts.

8. Condiments-Condiments are generally made available in liquid forms for the astronauts. Pouches are made available for the packaging of mustard sauce, tomato sauce, and mayonnaise.
The salt is dissolved in the water and pepper is in form of the oil is packaged in the polyethylene dropper bottle.

9. Tortillas- Tortillas are the types of bread that are also made from wheat and most liked by the astronauts, but there is a problem with the packaging of the tortillas cannot be preserved without refrigeration. Tortillas are a combination of acidity, water activity, and oxygen. There is immediate mold growth if not preserved properly. During the dough formation of the tortillas, water activity is reduced to 0.90 and lower acidity is maintained. Microbial growth can be reduced by the removal of the oxygen from the packaging material.

10. Freeze-dried foods- This type of food can be eaten directly without the addition of cold or hot water before consumption. These foods are generally pre-cooked or preprocessed, so there is no further refrigeration required. Only fruits and vegetables are exceptions because they easily deteriorate.

Packaging considerations

During the space food innovations, many parameters are taken into the consideration, one of them is the packaging of the space food and the beverages.

1. Mass- Mass of the space food and the beverage should be low since it makes it easy to carry at the space station

2. Volume- The volume of the food product should be not more than 3000kcal along with the packaging material.

3. Crew time- Crew time is the period where crew members are allowed to install the food products to the storage in their allotted shifts.

4. Water use- Water use is the amount of water utilized by food products.

5. Waste disposal capacity □ Waste disposal capacity is the amount of waste generated at the space station.

During the Apollo mission, the packaging era was beginning. Usage of the Plastics and the rigid cans was also introduced during that mission. In thermostabilised foods cans were replaced by aluminum foils and bimetallic cans. Skylab's mission reduced the usage of plastic spoons and bowls. NASA decides the packaging material by taking the mass, volume, water activity, and waste disposal capacity into the consideration. Packaging material is considered one of the most important factors during food innovation because it plays a very important role in preventing microbial growth, reducing the oxygen level, maintaining the acidity and pH, prolongs the shelf life, and making the food products much stable for consumption. Packaging acts as the barrier between the food products and the external atmosphere. Beverages products have foil layering the packaging material to prevent the beverage from the nitrogen and oxygen which is required beyond the shelf life of 18 months. Higher quality of the packaging material acts as a good barrier for controlling the oxygen levels in the food, but oxygen release can lead to oxidation which in result can destroy the nutritional quality of the space foods and beverages. Retort pouches are considered to be one of the effective packaging materials that has reduced mass and the volume requirements during the storage of the space food and the beverage. (7)

Functional space food

1. High in water- High in water to fulfill the requirement of adequate amounts of the fluids. The water requirement is about 2 litres/day, and very difficult to satisfy the thirst-quenching capacity. The consequences of the body fluid shifts are common because of the low fluid intake.

2. High in fiber content- Many probiotics and prebiotic fibers are recommended to reduce intestinal diseases such as constipation and the intestinal microbes

3. Rich in the calcium- Calcium is an important factor playing role in the preservation of the bone quality and quantity. It also helps in lowering kidney stones.

4. High antioxidant property- Antioxidant acts as good parameters for the body's defense mechanism against the free radical change in the body. Antioxidants enhance the radical change in the body and also modify them.

5. Low in sodium- Sodium chloride is responsible for the salty taste in the meals. It is also
Helpful to increase the shelf life of the products. The astronauts are provided with low sodium to prevent energy loss from the bones.

Functional foods include the unique ingredients that are helpful to retain the nutritional quality of the space foods. Functional foods are low in calorie. Functional foods act as an immunity booster for the astronauts. All the basic projects related to functional foods are acceptable to the scientists that are retaining the nutritional quality of the food. Many functional foods such as the extruded pasta, dehydrated beans, fruit drinks, lasagna, tortillas, and many gel-like snacks are used as functional foods for the astronauts.

**Applications of food technology in the space**

1. It provides an adequate food system
   01. A safe food system is to be developed.
   02. A nutritious food system is to be developed.
   03. An acceptable food system is to be developed.

2. It provides a system that can balance vehicle parameters
   01. Minimize the volume of the food.
   02. Minimize the mass of the food.
   03. To minimize the gas vehicle emissions.
   04. To minimize the crew time.
   05. To minimize the power required.

3. Goals
   A. High acceptability of the space food and the beverages.
   B. Minimum time should be required for the preparation.
   C. It should be highly nutritious.
   D. It should be easy to clean up.

Factors considered for space food preparation:

1. Weight loss
2. Fluid shift
3. Dehydration
4. Electrolyte imbalance
5. Calcium loss
6. Potassium loss
7. Decreased red blood cell mass

Their various factors are taken into considerations while designing the space food. Some important factors such as the space food and the atmosphere, convenience of the packaging factors, and the microbial attacks are widely studied during the preparation of the space food.

1. **Biological factors**

   The main to study the biological factors is to prevent microbial growth and prolong the shelf life of the food. It is also for the preservation of the astronaut’s health to prevent them from causing gastrointestinal problems, hence to avoid such problems sensory test by the crew members is taken into considerations. Also the hygiene practices are followed during the preparation of the space food and beverages.

2. **Operational factors**

   Food processing and food packaging are both parameters considered as operational factors. It also includes the preparation, food storage, packaging material, and waste disposal capacity are the constraints took into considerations under the operational factors. The main aim of the packaging material is to provide the barrier to the oxygen levels to bring about stability to the food product.

3. **Engineering factors**

   Engineering factors include checking the weight of the food and the packaging factors. The engineering factor also plays important role in the storage of space food. Engineering factors also include the quantity of water utilized. The food and the packaging material should withstand the temperature, pressure, external atmosphere and to maintain the oxygen level in order to prolong the shelf of the space foods and beverages.

**Innovations in space food:**

Innovations in space food are that looking forward to developing the nutritional and health taking the concern of the health of the astronauts. Innovation is making use of friendly packaging material to avoid the destruction of the atmosphere. Innovations in the storage as much required as there is a microbial attack in a short period of time,
Due to lack of the refrigeration system available at the space station. Scientists are also looking forward to supplying fresh fruits and vegetables to the astronauts, hence NASA is taking the task of performing experiments on space gardening in the coming years. NASA has stated that, it is crucial to growing the plants in space to maintain the environment, and which will also be beneficial for the astronauts for their survival in the coming years. NASA is also making experiments on the study of the crop functioning, for the development of the new products and enhance the space beverages through the alcohol industries.

Challenges for Space food:

1. One of the biggest challenges is eating in space, as well as space travel itself, is the biggest challenge ever, where everything floats around, Therefore food needs to be prepared, packaged, stored in a special way according to the conditions of the for space.

2. Nutritionists ensure that meals taken by the astronauts provide a balance between the nutrients and the energy they obtain.

3. Salt and pepper are available in liquid form, this is because they can easily flow in space, and hence cannot be sprinkled by the astronauts.

4. The packaging material should be very flexible and easier, and it must be chosen according to the food that is to be packed. Packaging material should also provide space to the containers.

Space beverage

On the 50th anniversary of the Apollo that the 11 moons were landing rapidly was one of the stories given by NASA, where the drink industry started approaching the tale of the Cocktail conference where the history with alcohol began. In 2016 Tales of the Cocktail Conference began with the series of seminars, until the food scientist from Barcadi had a discussion on the carbonation of the liquor. There was another tale called cosmic Cocktail which was included in the informal history of the drinking. Now the modern nature of space travel began which also brought the improvement in the eating and drinking of the astronauts. NASA still continues with the No Alcohol policy, but there was some space left to booze. Scientist Kluger from Apollo 8 along with Module Pilot James Lovell and William Anders was the very first crew that traveled across the moon, they were also the Astro alcohol pioneers. NASA was looking forward to the improvement of space food and beverages and wanted to have a proper meal for their scientist and the crew members from the Apollo 8 which was made to fly in the Christmas Holidays. According to the scientist Kluger. They were the first humans to drink in the space above the world. After Apollo 8, Apollo 11 was one step further towards mankind, and they took the first sip Buzz Aldrin who bought the wine and bread secretly on the mission for the celebration which was generally not accepted by NASA. One of them was Neil Armstrong who witnessed this historic moment. Later a booze bonus was given by NASA for the pioneers from the Apollo 11 which included the care package where, they met with bottle of scotch and the ice.

In 1972 NASA finally visited the idea including the alcohol to space. As mission durations began to become long, there was also improvement in the meal and the liquor or the wine. Deserted wines were the ones that were heated during the reprocessing and repackaging seemed to be very stable as the space beverage. UC Davis on the Skylab mission put forth an appeal to NASA for the involvement of the Sherry. Sherry was not involved because it did not meet the basic requirements of the space beverages according to NASA. Scott Kelly NASA’s supervision waited until he returned to sip the beer, as there is still alcohol restricted. Russian cosmonauts were provided with alcohol to keep them stress-free with high spirits. The future beverage in the space may ultimately rise, many highly innovative and high profile experiments are carried out such as fermenting the beer, tasting of whiskey in the zero-gravity, recycling of the resources is one of them to recycle fermentation-created with the CO2 for the brewers and the food scientists. Carbonated beverages such as champagne, the beer won’t be viable since bubbles rise up in the gravity. Gases get separated and rise up which leads to burps.

Introduction to space beverages

There is a strict prohibition of alcoholic drinks by NASA, but the very surprising amount of alcohol from American scientists to the Russian cosmonauts has traveled in the microgravity. Alcohol was strictly prohibited because it was harmful to the environment which
Was also stated by (ECLSS)Environmental Control and Life Support System. Astronauts mainly drink water in space, but nowadays flavored drinks are also available. Drink powder mixes in the form of freeze-dried powder of the tea and coffee are made available. Lemonades and orange juices are also made available, which are packaged in the pouches that are vacuum sealed. Astronauts add water pouches containing the mixes through the pressurized hose and then the drink is sucked using the straw. Drinking fluids in microgravity is done through the straw from the bags, and the bags can be refilled again. Many people still wonder which was the first drink consumed by the astronauts at the space station, and it was an eight hour mission during which the Coca-Cola was the first beverage that was consumed by the astronauts at the space flight stated by NASA. After that Coca-Cola was continuously bragging out the advertisements around the country which was also proclaimed by NASA. Since there is a restriction on alcohol consumption, but there is no restriction on the alcohol experiments at the space station. NASA takes care of the astronauts and the cosmonauts from getting intoxicated at the launch. In July 2007 there was a scandal in which astronauts to have flown while drunk, NASA admitted that their rules and regulations were vague. Carbonated beverages were the most unsuitable at the space which caused a lot of wet burps as the bubbles did not rise in the atmosphere. The Russian media stated that there is an official ban on the alcohol consumption, but the first drink sent to space was the bottle cognac in 1971. It was difficult drinking in the space as the liquid and the air got to mix up to form the forth. For the first time American astronauts saw the Russian cosmonauts got drunk at Mir mission, after that NASA tried to release the photograph of 1997. Cognac party. In 2006 the International Space Station (ISS) banned the cosmonauts from drinking as the proposal of drinking was lifted by the ISS, as the campaign was considered as one of the dangerous drinks. Cosmonauts at the Mir mission were allowed the alcoholic drink s such as cognac, vodka, and very special ginseng liquor. [Journal of the Institute of Brewing/Volume 68, Issue 6, November-December 1962]

Beverages:

Beverages are widely classified as alcoholic and non-alcoholic, carbonated and non-carbonated in the terms of space beverages. Due to lack of refrigeration at the space station, beverages are available in the form of powder such as coffee, tea, apple cider, orange juice, lemonade. The packaging material chosen for the beverages is generally pouches or the cans, but they consist of thin Aluminium foil coated from inside, so that then can act as good barrier between the beverages and the external atmosphere to maintain the levels of the oxygen and to prevent the microbial growth on the beverages. When beverage powder is added to packaging material, along with it septum adapter is sealed with it. The septum adapter plays a very important role in interfacing with galley water dispenser for the addition of the water and also provided with the straw for the consumption of the beverages. Space beverages that are available in the form of the powder such as the glucose, apple juice, lemonade, orange juices are manufactured at Chengalpatti, Tamil Nadu is the leading manufacturer of the space beverages which was established in the year 2017. This industry is also the leading supplier the space beverage products. They have the finest and the premium quality of the space beverage powders, so they are the top sellers of the space beverages.

The space beverage launches

The space beverage industry have witnessed the wealth that is gained in the space beverage in the recent years. The health was the main reason for which NASA had forbidden the consumption of the alcohol in 1970. Due to awful stench of champagne was declared as the dangerous drink. The research has found that a chemical compound called resveratrol is present in the wine is helpful in the preservation of the mass and the energy in the rats in the microgravity. Scientist Ardbeg sent distillery to the space for the microgravity effect on the aging of the whiskey in year 2017. Last year Oregon brewery Bridge port also started with their launch and designed the helium balloon used for the flagship IPA. Two classics star war and the star trek of space sci-fi had the influence on the beverage industry. Star war franchise is engaged in the operations of the winemaking named as the Skywalker Vineyards. Englishman working at the Chile was the first to launch aged wine in the space in the

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Year 2012. In the valley of the Chile the extra terrestrial wine was created at Hutcheon’s tremonte vineyard which estimated the budget of 4.5 billion dollars was launched in the year 2009. Chateau meyney, prieure des couleys was drunk by Gagarin and Vladimir Komarav to celebrate the selection in the Russian mission in the year 1960, but later the rocket got crashed in the mission and the bottle remained unsold forever. US craft brewery Dogfish Head decided to launch new beer by mixing up all the things and he moondust was their main ingredient. The meteorites were made into powder and then added into the fermenting beer to create the Celest-jewel-ale in the year 2013.

Champagne Mumm entered into space beverage in very recent years with the new fizz and the glass bottle that uses pressure to expel the drink in the zero-gravity which looks like a droplet of the bubbles. Moonwalker Cabernet sauvignon is with collaboration boutique winery Holman cellars in the Napa Valley which is also one of the finest wines. An astronaut who walked on the moon was the seller for this wine and the profits of the wine are donated to Cosmosphere which is a science-based museum and its launch was done in the year 2015. Dr. Jason Held used the modified technique of the unique surface of the moon and the sensation of floating in space consists of the black aluminum bottle that has the special property of wicking that allows the beer to flow in the zero-gravity which is recent launch. Cosmic Lifestyle Corporation (CLC) was started with zero gravity cocktails and martini glasses for improving the comfort of the astronauts, they had the project on the 3D machines that took nearly 15 hours to complete one glass, this project launch was taken place in the year 2015. AB InBev-Owned Budweiser joined the race of space beverage and was the first industry to beer on the red planet called Mars. Scientist spends about 30 days for the analysis and the shipped back to the earth, to perform crop function at the space. this launch was completed in the year March 2017.

Innovations in the space beverage:

Recent innovations look forward to the setup of the distilleries at the space station to carry out different fermentation of the alcoholic drinks. Also, the most innovative is the addition of black Aluminium foil to the alcohol bottles that allow free flow of alcohol in zero gravity. Development of the 3d printed glasses is the major project of the innovation. Some reputed brewing industries look forward to the development of more enhancing flavors. There is also a complaint from the astronauts about color changes of the alcohol. Distillation is impossible to be done in the space, as the liquid volumes required in the space are very high, and setting up the distilleries is the major project undertaken by the many brewery industries. There are also many industries performing the experiment to check out the crop conditions at the space to ensure the development of fermentation of the grains for the production of the beer.

Drinking in the space:

Astronauts usually have to take care while consuming the liquids at the space station, as the liquid should not spill, as it may cause damage to some delicate equipment. They have specialized tubes that allow them to drink any liquid without floating around the space station. The water available is many times is recycled through astronauts' sweat and urine. At higher altitudes, there are fast oozing effects. Hence consumption of alcohol is avoided, as it causes more bizarre effects on the astronauts. One of the main reasons to avoid the alcohol in the space is readings. Volatile compounds and alcohol are totally under the control of ISS, as they have an effect on the astronauts. Even products that contain volatile compounds or alcohol such as mouthwash, perfumes, aftershave lotions are strictly prohibited. Jet pilots have the responsibility of the spacecraft, so they are not even allowed to get drunk at the ground state. If a heavy amount of alcohol is consumed at preflight does not assure evidence of safety is stated by NASA. Astronauts are strictly not allowed to drink 12 hours before the space flight. There was also failure with sherry which was allowed in the Skylab mission, astronauts had a complaint about the taste of the sherry. Japanese brewer also had experimented with the whiskey, but he experienced the mellowness in the alcohol. There was a case study in which from year September 2011 to 2014, NASA had sponsored an experiment which included the study of whiskey, the tannins in the whiskey did not change, also the
Flavor of the wood chips was enhanced, as there was lignin breakdown in the whiskey, Tea, coffee or the juices are available in the form of the powder, but for the coffee in the pouches can be consumed in the form of the bubbles. Sodas are also avoided because they contain carbon dioxide which are not buoyant in the environment which is weightless, but the fluids get randomly distributed even after swallowing as if forms the messy forth during traveling the space.

Challenges for space beverages:
Carbonated drinks form the messy structure of the space, hence making them stable is the major challenge of food scientists. Coca-cola and Pepsi for the very first time in 1985 sent their beverage for tasting at STS-51-F, which failed due to the lack of the dispenser in the beverage pouches or bottles, the beverage was flown in space, so the stability of the beverages is a challenge for the much-reputed industry. At the Russian Mir mission, pepsi cans were carried in the year 1986, which was also a failure due to the lack of stability of the beverage. The main challenge of the space beverage is to retain the original colors and the flavors of the beverages at the space station. Due to the wet belches in space, many times astronauts face nausea and vomiting. There is a lot of reduction in the flavor of the beverages due to lack of refrigeration is also a major challenge of the storage of the beverages at the space station. Wet-belches also reduces the original smell of the beverages. Retaining the original flavor and color along with the chemical compound called reversterol present in the wine is also the major challenge faced by the alcohol industry.

Major challenges of space food and beverages:
1. Use of plastics - The beverage industry faces great challenges to reduce the usage of plastics and increase the use of the environment-friendly packaging material, for their sustainability with the increasing demands.
2. Regulatory burdens, According to the U.S food safety and modernization act, there should be proper documentation of the waste disposal capacity.
3. Demand in forecasting - Forecasting helps the companies to know the accurate data of the purchase and the sales and also helps for the growth of the industries.
4. Making the food and the beverages more functional.
5. Try different innovation cycles.
6. Reducing the sugar levels in many food products and beverages.
7. To meet the demand for natural and the organic foodstuffs

Conclusion
The space food and the beverages that are consumed by the astronauts do not have any mysterious concoctions, but all the food items are prepared on the earth since there is no such setup of the food industry in space. The major challenges accepted by the companies are the improvements in the preparation, processing, storage, and packaging material used. Scientists are also looking forward, to increase the nutritional value of space food taking the health concerns of the astronauts into considerations. To prolong the shelf life of food during the longer duration missions and preventing the foodstuffs from the microbial attacks is the main area where scientists are focusing. Value addition products and their compatibility in zero gravity is also studied by food scientists. The space food and beverages that are made available to the astronauts and the crew members do not cause harm to the environment at the space station and do not lead to the destruction of the equipments. Scientist focusing on future developments are as follows;
1. To use environment-friendly packaging material which is also bio-degradable in nature.
2. To make foodstuffs more palatable and digesting.
3. Waste disposal capacity should be decreased, looking forward to the development of recycling the products.
4. Food coating should be made edible.
5. Packaging material used should be multifunctional in nature.
6. There should be a balance between the usage of the raw material and the nutritional output of the products.
7. Food hygiene should be maintained.
8. Food should be free from microbial attacks.

Astronauts during the long duration of the missions remain half-starved and in many left to be malnourished is the major issue of the space food and the beverages. Many a time they sacrifice the lavish feel of the dining tables, usage of the utensils, and obviously their favorite meals and have to consume meals are available and lacking in the nutrition which is never overlooked. To overcome such issues new technologies are emerging to retain the health of the astronauts such as space gardening, storage, and improving the quality of space food and beverages.

Making the space beverages more stable for consumption at the space station is one of the major projects undertaken by the food scientist and it is sponsored by NASA. Another parameter is the retention of the colors and the flavors in the space which deteriorate easily. Innovations in the designing of the glasses were the major project undertaken in the terms of the space beverage industry. Also, food scientists are looking forward to designing 3D glasses to prevent the spillage of alcohol in the space station. Packaging of the carbonated beverages is taken into considerations, as the carbon dioxide from it is flown away in the space station that can harm the environment as well as the artificial objects and the equipment at the space stations.

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