Systematization of Technical-Scientific Information on Dehydration and Freeze-Drying of Fruits in the Universities of Ecuador

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Abstract

The present study was carried out to systematize the technical-scientific information on dehydration and freeze-dry in fruits generated in the universities of Ecuador through the development of research with a qualitative and quantitative approach, applying a descriptive, bibliographic and documentary level of research, with a non-experimental research design. The work responds to a theoretical descriptive analysis of the scientific support reported by the authors according to the different degrees of works on dehydration and freeze-drying in fruits. The execution of this work had the following research fields: exploration, classification, processing and analysis of files found in the repositories of the universities. For the analysis of the information, descriptive statistics were used. For the present work, the Microsoft Access program was used to create a database of all the information collected, taking into account the following systematization fields: code, subject, link, authors, university, keywords and summary. According to the database, 33-degree works were systematized, of which the university that carried out the most works on dehydration and freeze-drying in fruits is the Agrarian University of Ecuador, with 5 publications from 2015 to 2022. The 2 careers that have done more work are the career of food engineering and the career of agribusiness, with 11 and 10 publications, respectively. And the year with more publications was 2021, with 9 works carried out in the different universities of Ecuador. Concluding that dehydration and freeze-drying are very beneficial methods to maintain and prolong the shelf life of the fruit while preserving the nutritional and organoleptic characteristics, it is recommended to improve knowledge in the use of Microsoft Access to provide accurate and quality information to the student.

Keywords: *DESHYDRATION, LYOPHILIZATION, SYSTEMIZATION, SCIENTIFIC TECHNICAL, FRUITS, DATABASE, CONSERVATION, AGROINDUSTRY.*

INTRODUCTION

Nowadays, for fruit dehydration and freeze-drying, varied information serves as a basis for research in this field, allowing continuous improvement, satisfying consumer demand, and prolonging and maintaining the organoleptic and nutritional characteristics of the fruit.

All this relevant information existing on the web is scattered and unanalyzed. For this reason, following the proposed objectives, the present work systematized the information found in the repositories of the universities by means of the exploration, compilation, processing and theoretical descriptive analysis of the thesis works found in the repositories of the different universities.

Thus the database was created with Microsoft Access, and even though due to not have much knowledge of the program, I got stuck, but with the help of the teacher in charge of the degree work and video tutorials, I was able to complete this work, being this of much acceptance and gaining space in society in the realization not only of systematization in dehydration and freeze-drying in fruits but in other areas such as guayusa where we are working on dehydration to obtain crushed guayusa with an association called "Ruku Kawsay Wayusa" of the Napo province.

Laying the first stone in terms of this type of work of systematization of technical-scientific information on dehydration and freeze-drying in fruits fills me with pride because there are no works of this type in other universities and ESPOCH through the Faculty of Livestock Sciences and the career of agribusiness, is the first to do it, so I am sure that this work will be of great help to students and teachers of different academic levels and if the society in general who need to investigate on the subject, and thus encourage the interest to investigate.

The document will be uploaded to the university repository, and the database file will be available through a link where all the information required by the student or researcher can be accessed.

RESEARCH METHODOLOGY

The methodology applied in this work responds to a theoretical descriptive analysis of the scientific support reported by the authors on the other undergraduate research works on dehydration and freeze-drying of fruits. In this way, the execution of this work had the following methodological fields of research: exploration, classification, processing and analysis of files found in the repositories of the Universities of Ecuador.

Data collection process

- For the collection of information, all the universities in Ecuador that offer courses in agribusiness, food and chemistry were identified as the most important ones.
- A list of universities in Ecuador was created.
- Once the universities were identified, thesis works were searched for in each university's different Dspace or virtual libraries.
- I compiled all the information found in Word.
- I systematized all the information in access according to each field or factor I took into account to elaborate it.

Methods for systematization of information

The present research work was carried out through the following systematization process:

- According to the unitary operation, the word dehydration was typed into the Microsoft Access program, followed by the fruit's name and the keywords depending on the degree works collected.
- The same was done for the freeze-drying method.

Statistical methods

Descriptive statistics were used where it was classified by keyword and university. The database was based on several fields where a research code was assigned, sorted as shown in the following table:

Table 1. Fields to systematize the information.

Code	
Subject	
Link	
Authors	
University	
Keyword	
Summary	

Source: Salazar (2022).

RESULTS AND DISCUSSION

Table 2. Bibliographic research on dehydration and freeze-drying of fruits carried out at universities in Ecuador.

No.	University	Author	Subject	Year of publication
1	Central University of Ecuador	Mauro Daniel Muñoz Cachago.	Evaluation of fruit dehydration systems of two varieties of Carica papaya: Solo sunrise (Hawaiian) and Tainung, to obtain total carotenoids as a source of natural colorants.	2018
2	Central University of Ecuador	Juan Carlos Pérez Luna	Obtaining dehydrated soursop powder by spray drying.	2017
3	Central University of Ecuador	Shigla Cup Maria Fernanda	Drying of arazá (Eugenia stipitata) pulp in a pilot plant dryer by the atomization method.	2021
4	University of the Americas	Edison Augusto Pasquel Vásquez	Evaluation of dehydration methods in pitahaya (Selenicereus megalanthus), for the utilization of fruit that does not meet fresh export standards.	2016
5	University of the Americas	Roberto Paúl Gualoto Romero	Use of dehydrated fruits in haute cuisine providing aroma, color and flavor.	2018
6	National University of Chimborazo	Bryan David Escobar Vega	Analysis of dehydration techniques for apples (Golden delicious) and blackberries (Rubus glaucus) produced in Cantón Cevallos.	
7	National University of Chimborazo	Allauca Asqui Rosa Angela	Use of agro-industrial wastes, based on carrot (daucus carota), beet (beta vulgaris) and blackberry (rubus glaucus) peel for a freeze-dried beverage.	2019

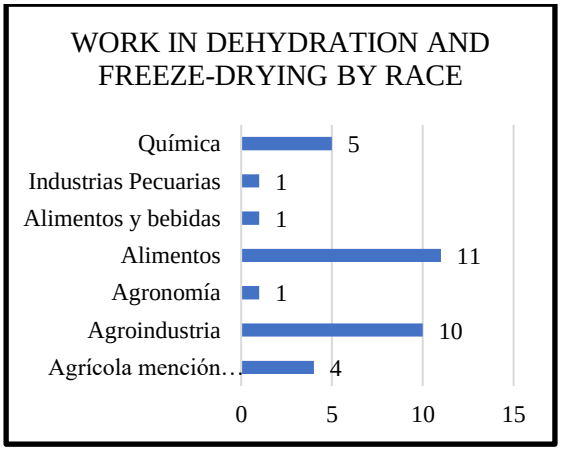
8	National University of Chimborazo	Jessica Verónica Guamangallo Tandalla	Determination of the antioxidant effect of ascorbic acid at different concentrations and ripening time in banana (musa cavendish) for dehydration.	2018
9	University of Azuay	Paola Gabriela Duchitanga Torres	Analysis of the antioxidant capacity of fruits and vegetables subjected to freezing and freeze-drying.	2018
10	Higher Polytechnic School of Agriculture and Livestock of Manabí	Carolina Stefania Carranza Giler and Yohan Gabriel Luna Velásquez	Evaluation of sweet whey and freeze-dried passion fruit (Passiflora edulis) pulp in a functional fermented milk drink.	2020
11	Higher Polytechnic School of Agriculture and Livestock of Manabí	Martha Nataly Taffur Párraga and José Andrés Zambrano López	Osmotic dehydration with two sweetening agents for the preservation of uvilla (Physalis peruviana L.).	2019
12	Carchi State Polytechnic University	Morán Delgado Verónica Pilar	Effect of chemical peeling as a pretreatment in the dehydration of uvilla (Physalis peruviana L.).	2021
13	Carchi State Polytechnic University	Benavides Tulcán Karol Elizabeth	Effect of pretreatment (blanching) on dehydration of pineapple (Ananas comosus) variety Sweet Golden or MD2.	2021
14	Carchi State Polytechnic University	Quilumbaquin Guachamin Yajaira Lizeth	Osmodeshydration as an alternative for improving the sensory characteristics of conventionally dehydrated strawberries (Fragaria vesca; Albion variety).	2019
15	Technical University of Ambato	Diego Fabian Chaglla Moyolema	Osmotic dehydration of pumpkin (Cucurbita maxima Duchesne).	2016
16	Technical University of Ambato	María Gabriela Carvajal Castro	Effect of osmotic dehydration pretreatment in pineapple (Ananas comosus; Cayenne lise variety) on drying kinetics using an airflow tray dryer.	2016
17	Technical University of Ambato	Mayra Ximena Casillas Paste	Design of the osmotic dehydration process for cidrayota (Sechiumedule) of the virens levis variety.	2019
18	Technical University of Cotopaxi	Catota Muela Edwin Geovanny and Chiluisa Chicaiza Franklin Mauricio	Comparative study between the process of convection drying and freeze-drying in the production of mortiño powder (Vaccinium floribundum kunth).	2022

19	Equinoctial Technological University	Sebastián Mena Muñoz	Study of the osmotic dehydration of pumpkin (Curcubita maxima).	2016
20	Equinoctial Technological University	Andrea Elizabeth Vizuete Carrera	Preparation of a film with mango (Mangifera indica L) pulp and yellow tree tomato (Solanum betaceum) with and without concentration.	2017
21	Equinoctial Technological University	Andrea Estefania Bustos Barragan	Effect of osmotic dehydration on antioxidant capacity in yellow and purple tree tomato (Cypomandra betacea).	2015
22	Higher Polytechnic School of Chimborazo	Paulina Alexandra Hipo Hipo	Study of a freeze-dried sucrose plus blackberry (Rubus glaucus) mixture for application in the food industry.	2021
23	Quevedo State Technical University	Karina Margoth De La Cruz Vichicela	Exploitation of the antioxidant capacity of cocoa (Theobroma cacao L.) pulp juice of clone CCNN-51 and national varieties (above) by spray drying.	2021
24	Quevedo State Technical University	Quijije Rendón Andreina Elizabeth	Study of quality parameters and sensory characteristics of two varieties of pink pitahaya (Hylocereus undatus) and yellow pitahaya (Selenicereus megalanthus) for their application in agroindustrial processes.	2021
25	Quevedo State Technical University	Véliz Lima Luis Ignacio	Preservation of tropical fruits by the combined methods of osmodeshydration and hot air dehydration.	2016
26	Superior Polytechnic School of Litoral	Cristina Borbor Auria and Edgar Loor Calle	Preparation of a freeze-dried product from red pitahaya pulp.	2021
27	Agrarian University of Ecuador	Alcívar Luna Amanda Suany	Application of adiabatic dehydration in the production of dehydrated fruit bars.	2019
28	Agrarian University of Ecuador	López Cedeño Juan Alberto	Efficacy of three dehydration methods in mandarin (pokan) for obtaining dehydrated snacks.	2021
29	Agrarian University of Ecuador	Barreto Barreto Joselyn Jazmin	Evaluation of vitamin c and polyphenol loss in osmodeshydration of kiwifruit (actnidiachinensis) infused with moringa (moringa oleifera).	2021
30	Agrarian University of Ecuador	Izquierdo Paredes Carla Michele	Evaluation of three types of sucrose concentrations in the osmotic	2019

			dehydration of mango (mangifera indica) tommy atkins variety.	
31	Agrarian University of Ecuador	Michelle Paola Marín Barrionuevo	Influence of osmotic dehydration of apple on the loss of vitamin C.	2016
32	University of Guayaquil	Miguel Ángel Asqui Quishpe and Adriana Alexis Cortez Perez	Effects of freeze-drying on the antioxidant activity of arazá (eugenia stipitata McVaugh).	2022
33	Technical University of Machala	Espinoza Roblez María Fernanda	Technological process of convective dehydration of pineapple (ananas comosus).	2018

Table 2 shows the information collected and obtained from the DSpace repositories of the universities of Ecuador regarding dehydration and freeze drying in fruits finding a total of 33 thesis works from 2015 to 2022, where the Universidad Central del Ecuador, Universidad de las Américas, Universidad Nacional de Chimborazo, Universidad del Azuay, Escuela Superior Politécnica Agropecuaria de Manabí, Universidad Politécnica Estatal del Carchi, Universidad Técnica de Ambato, Universidad Técnica de Cotopaxi, Universidad Tecnológica Equinoccial, Escuela Superior Politécnica de Chimborazo, Universidad Técnica Estatal de Quevedo, Escuela Superior Politécnica del Litoral, Universidad Agraria del Ecuador, Universidad de Guayaquil and Universidad Técnica de Machala, are the universities that perform dehydration and lyophilization in different varieties of fruits that our country has, some apply techniques known since ancient times as dehydration or solar drying, and other more modern techniques such as freeze drying, osmodeshidratación and spray drying or atomization.

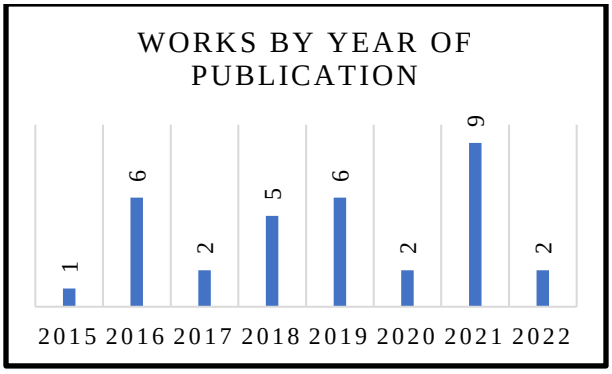
Figure 1. Dehydration and freeze-drying work by career.



Source: Salazar, Q. 2022

As shown in Figure 1, the career that has more studies in terms of dehydration and freeze-drying in fruits in the universities of Ecuador is food, with a total of 11, followed by the career of agroindustry with 10 works and the career of chemistry with 5 works, these are the 3 careers with more studies done during the period 2015-2022. While the other careers have 1 and 4 works, such as livestock industries and agriculture, mention agroindustry.

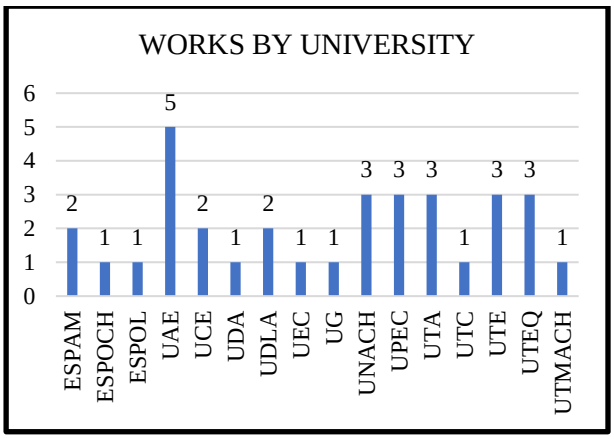
Figure 2. Number of papers by year of publication.



Prepared by: Salazar, Q. 2022

In Figure 2, it is observed that in the year 2021, 9 undergraduate papers on dehydration and lyophilization in fruits have been published. In 2016 and 2019, 6 undergraduate papers were published; in 2018, there were 5 publications, while in the other years, there were 1 and 2.

Figure 3. Number of papers per university.



Prepared by: Salazar, Q. 2022

Figure 3 shows the amount of work done in different universities in Ecuador on the dehydration and freeze-drying of fruits. The Agrarian University of Ecuador has carried out 5 works in total, and universities such as UNACH, Universidad Politécnica Estatal del Carchi, Universidad Técnica de Ambato, Universidad Tecnológica Equinoccial and Universidad Técnica Estatal de Quevedo have carried out 3 works, while the other universities have carried out 1 and 2 works.

Table 1-4. Analysis of the most relevant information from the research.

Quotations	Relevant aspects
Bustos (2015)	**Subject:** Effect of osmotic dehydration on antioxidant capacity in yellow and purple tree tomato (Cypomandra betacea). **Objective: To** determine the effect of osmotic dehydration on the antioxidant capacity and anthocyanin content of yellow and purple tree tomatoes (Cypomandra betacea). Keywords: Tree tomato, fruit dehydration, food industry. **Conclusion:** During the osmodeshydration process, the higher the temperature, the osmotic equilibrium is reached in less time. The degree of concentration of syrup or invert sugar solution and the temperature used in osmodeshydration influences the antioxidant capacity for yellow and purple tree tomatoes.
Véliz (2016)	**Subject**: Preservation of tropical fruits by combining osmodeshydration and hot air dehydration methods. **Objective**: To preserve tropical fruits (Tommy atkins mango, Cartagena mamey and Hawaiian papaya) by combining osmodeshydration and hot air dehydration. **Keywords**: Combined methods, sweeteners, tropical fruit preservation. **Conclusion:** In terms of moisture in dehydrated fruits, they are within the range established by the Ecuadorian national regulations regarding dehydrated products,

	where the times and temperatures applied are associated with the standard. So the T° for dehydration processes is 50 ° C for 8 hours to preserve them for 6 months. For the osmotic dehydration process and to obtain better results of the final product (color, odor, texture and flavor), it is necessary to use stevia at 60 °Brix with 7.23% moisture.
Marin (2016)	**Topic:** Influence of osmotic dehydration of the apple in the loss of vitamin c. **Objective: To** evaluate the influence of osmotic dehydration of apple on vitamin C loss. **Keywords**: osmotic dehydration, vitamin C, Brix degrees. **Conclusion:** The aspects that influenced the loss of vitamin C in the apple were the concentration of the sweetener and, even more, the temperature with which they worked since due to the change and increase of T° to 60 ° C accelerates the speed of dehydration and with it increases the gain of solids causing the loss of vitamin C. According to this research work, the optimum for osmotic dehydration process is a temperature of 40 ° C to 65 °Brix for 2 hours. According to this research work, the optimum for this osmotic dehydration process is a temperature of 40 ° C to 65 ° Brix for 2 hours.
Pasquel (2016)	**Subject:** Evaluation of dehydration methods in pitahaya (Selenicereus megalanthus), for the utilization of fruit that does not meet fresh export standards. **Objective**: To evaluate methods for dehydration of pitahaya fruit (Selenicereus megalanthus), which does not meet fresh export standards. **Keywords**: Agroindustry, pitahaya, dehydration, dehydration **Conclusion**: The best method to dehydrate pitahaya is convection dehydration (70 ° C:12 h) where the fruit is better preserved and maintains balance in nutritional and microbiological aspects (10 CFU/g).
Mena (2016)	**Subject**: Study of the osmotic dehydration of pumpkin (Curcubita maxima). **Objective: To** obtain cubes of sweet pumpkin (Cucurbita maxima) by applying osmotic dehydration. **Keywords**: food dehydration, pumpkin, osmotic dehydration. **Conclusion:** Soluble solids after Osmo-dehydration increased from 6.2 ° Brix in fresh squash to 30.88 ° Brix in dehydrated cubes. Vitamin C content was not affected by either blanching, osmo-dehydration or hot air dehydration. When applying this dehydration method, the microbiological requirements were within the specifications (E. Coli < 10 CFU, Molds < 10 UPM) of the Ecuadorian standard INEN 1529.
Carvajal (2016)	**Subject:** Effect of osmotic dehydration pretreatment in pineapple (Ananas comosus; Cayenne lise variety) on drying kinetics using an airflow tray dryer. **Objective: To** determine the effect of osmotic dehydration pretreatment in pineapple (Ananas comosus; Cayenne lise variety) on drying kinetics using an airflow tray dryer. **Keywords**: pineapple (Ananas comosus), biactive compounds, osmotic dehydration. **Conclusion:** The drying kinetics presented a similarity in dehydrated pineapples, based on the osmodeshidratación pretreatment used. Increasing the sugar content up to 12 % and the humidity losing from 2 to 5 % of the dry weight. In order to dehydrate the pineapple in a dryer, the optimum conditions are temperature of 70 ° C, time 5 h and airspeed 0.8 m/s.
Chaglla (2016)	**Subject:** Osmotic dehydration of pumpkin (Cucurbita maxima Duchesne) **Objective: To** determine the physicochemical characteristics and optimum sensory properties of pumpkin subjected to osmotic dehydration.

	Keywords: Pumpkin, honey, nutritional value. **Conclusion:** From the sensory point of view, the best product was the one with a content of 50 ° Brix and a temperature of 70 ° C, highlighting flavor, aroma, color and texture. With a shelf life of 60 days at room temperature.
Perez (2017)	**Subject:** Obtaining dehydrated soursop powder by spray drying. **Objective**: To determine the influence of maltodextrin on the product's characteristics obtained by varying the feed flow of the spray drying process. **Keywords**: Spray drying, soursop, Anona muricata. **Conclusion**: The moisture content of the powder obtained increases with increasing Maltodextrin/pulp ratio and regulation of the pump speed. The optimum moisture content of 3.67% is obtained at a speed of 6 and a ratio of 4% Maltodextrin/pulp. This value is within NTE INEN 2471 Requirements for preparing powdered mixes and beverages.
Vizuete (2017)	**Subject**: Preparation of a film with mango (Mangifera indica L) pulp and yellow tree tomato (Solanum betaceum) with and without concentration. **Objective**: To elaborate a film with mango (Mangifera indica L) pulp and yellow tree tomato (Solanum betaceum) with and without concentration. **Keywords**: Dehydration, snack, tamarillo. **Conclusion**: The dehydration parameters at 60 °C with 4 mm of thickness obtaining final humidities between 7 % to 19% for sheets without concentration and from 1 % to 7% for sheets with concentration. When the acceptability tests were carried out in terms of appearance, color, odor, flavor and overall acceptability, it was found that the sample with 100 % mango without concentration had the highest acceptability.
Espinoza (2018)	**Subject**: Technological process of convective dehydration of pineapple (ananas comosus). **Objective**: To review scientific articles and trials to evaluate two dehydration methods, osmo-convection and convective dehydration, applied to pineapple (Ananas comosus). **Keywords**: Dehydration, osmotic, convective. **Conclusion:** It was possible to dehydrate pineapple pulp by two methods, convective and osmotic-convective, being more efficient than the osmotic-convective method with 88% dehydration. In the osmotic-convective dehydration, by adding ascorbic acid to the pineapple, enzymatic browning is avoided, and the dehydration process is accelerated.
Muñoz (2018)	**Subject**: Evaluation of dehydration systems of the fruit of two varieties of Carica papaya: Solo sunrise (Hawaiian) and Tainung, to obtain total carotenoids as a source of natural colorants. **Objective**: To evaluate the effects of the dehydration system and the variety of Carica papaya: Solo sunrise (Hawaiian), and Tainung, on the number of total carotenoids extracted. **Keywords**: Dehydration, freeze-drying, tray drying. **Conclusion:** Obtaining total carotenoids benefits when the following conditions are met: a dehydration system such as freeze-drying is used for C. papaya fruits of the Solo sunrise variety.
Duchitanga (2018)	**Subject**: Analysis of the antioxidant capacity of fruits and vegetables subjected to freezing and freeze-drying. **Objective**: To quantify the CA of the fruits and vegetables with the highest production in the canton of Paute: tree tomato, kidney tomato and babaco subjected to preservation methods: freezing and lyophilization.

	Keywords: Antioxidant, Solanum betaceum, Carica pentagona. **Conclusion:** Indeed, processes such as freezing and lyophilization alter the antioxidant content; the former affects much more due to the combination of processes such as pasteurization and blanching prior to freezing; also, prolonged storage times alter the antioxidants significantly.
Guamangallo (2018)	**Subject**: Determination of the antioxidant effect of ascorbic acid at different concentrations and ripening time in banana (musa cavendish) for dehydration. **Objective**: To determine the antioxidant effect of ascorbic acid at different concentrations and to ripen time in banana (Musa cavendish) to be dehydrated. **Keywords**: Ascorbic acid, antioxidant, banana. **Conclusion:** Ascorbic acid significantly maintains the nutritional properties of the banana, i.e., it does not affect the nutritional quality of the dehydrated banana. Determining that the best ripening stage for the dehydrated banana was the yellow stage with a green tip with 500 ppm of ascorbic acid for a submergence time of 10 minutes.
Gualoto (2018)	**Topic:** The use of dehydrated fruits in haute cuisine provides aroma, color and flavor. **Objective**: To present the different culinary techniques that can be applied with these products. **Keywords**: Food preservation, dehydrated foods, fruits. **Conclusion:** Dried fruits currently have growth trends as a good ingredient or accompaniment to various dishes of direct consumption, making us market and potentiate for our gastronomy.
Quilumbaquin (2019)	**Subject:** Osmo-dehydration as an alternative for improving sensory characteristics of conventionally dehydrated strawberry (Fragaria vesca; Albion variety). **Objective: To** apply osmodeshydration as an alternative to improve the sensory characteristics of conventionally dehydrated strawberries (Fragaria vesca; Albion variety). **Keywords**: osmotic dehydration, sensory, microbiological quality. **Conclusion:** Osmotic dehydration as a pretreatment improves the sensory characteristics (color, odor, flavor and texture) of conventionally dehydrated strawberries (Albion variety). In the sensory analysis, the best treatment was T5, which corresponds to: sucrose concentration in the syrup of 50 ºBrix, an air temperature in the dehydrator of 60 ºC for a time of 6h, which had the highest acceptance by the judges.
Allauca (2019)	Subject: Use of agro-industrial wastes, based on carrot (daucus carota), beet (beta vulgaris) and blackberry (rubus glaucus) peel for a freeze-dried beverage. **Objective**: To obtain beverage from agro-industrial wastes by freeze-drying carrot peel (Daucus carota), beet peel (Beta vulgaris) and blackberry (Rubus glaucus) residues. **Keywords**: Beverages, waste, freeze-drying. **Conclusion:** Different formulations were made for the preparation of beverages based on freeze-dried powders of beet peel, carrot peel and blackberry residues at concentrations of 0.06, 0.12 and 0.18%, giving nine treatments, which were evaluated by a panel of tasters.
Taffur et al. (2019).	**Subject:** Osmotic dehydration with two sweetening agents to preserve uvilla (Physalis peruviana L.). **Objective: To** establish the effect of sweetening agents on osmotic dehydration to preserve uvilla (Physalis peruviana L.). **Keywords**: Uvilla, osmodeshydration, mass loss.

	Conclusion: The osmotic solutions with sucrose favored the physicochemical properties of grapefruit, achieving an increase in pH and a decrease in acidity, which favored greater sensory acceptance.
Alcívar (2019)	**Subject:** Application of adiabatic dehydration in the production of dehydrated fruit bars. **Objective**: To apply adiabatic dehydration in the preparation of fruit bars based on pineapple (Ananas comosus), mango (Mangifera indica) and pitahaya (Hylocereus undatus). **Keywords:** Food, energetic, fatty acids. **Conclusion:** The process of elaboration of the energy bars and packaging is completely aseptic, which was corroborated by the microbiological analyses performed, with a growth < 10 CFU in mesophilic aerobes, total coliforms, E. coli, fungi and yeasts, establishing a shelf life of 3 months.
Izquierdo (2019)	**Subject**: Evaluation of three sucrose concentrations in the osmotic dehydration of mango (mangifera indica) tommy atkins variety. **Objective: To** evaluate the three types of sucrose concentrations in the osmotic dehydration of mango (Mangifera indica) Tommy Atkins variety. **Keywords**: osmotic dehydration, yeast, microbiological. **Conclusion**: The osmotic dehydration of the Tommy Atkins variety mango, in different concentrations of sucrose (60, 70, and 80 °Brix), the immersion time and osmotic medium were important for the increase of solutes and decrease of humidity of the product, while the temperature during the process and the geometry of the mango favored the organoleptic characteristics.
Casillas (2019)	**Subject**: Design of the osmotic dehydration process for cidrayota (Sechium edule) of the virens levis variety. **Objective**: To design an osmotic dehydration process for Cidrayota (Sechium edule) of the virens levis variety. **Keywords**: Food preservation, osmotic dehydration, cidrayota. **Conclusion:** The proximal composition of the final product (dehydrated fruit) showed a content of 10.22% moisture, 0.136% fat, 1.69% protein, 7.96% total dietary fiber, 77.09% total carbohydrates, 305.96 (kcal/g) energy and 4.72 N hardness (texture). Thus, it is concluded that it is an energetic food with low humidity, adequate for its conservation.
Escobar (2020)	**Subject**: Analysis of dehydration techniques for apple (Golden delicious) and blackberry (Rubus glaucus) produced in Cevallos Canton. **Objective**: To analyze the dehydration techniques for apples (Golden delicious) and blackberries (Rubus glaucus) produced in the Cevallos canton. **Keywords**: Dehydration, drying, freeze-drying. **Conclusion:** Dehydration eliminates 90 to 95% of moisture from the food, while freeze-drying eliminates 99% of moisture and preserves a greater amount of nutrients and vitamins, therefore this method was selected to preserve the quality of dehydration before and after the process, one of the main advantages is that it maintains the sensory properties of the product.
Carranza et al. (2020)	**Subject:** Evaluation of sweet whey and freeze-dried passion fruit (Passiflora edulis) pulp in a functional fermented milk drink. **Objective**: Establish the doses of sweet whey and freeze-dried passion fruit pulp to elaborate a fermented milk drink with functional characteristics. **Keywords**: Total polyphenols, antioxidant capacity, functional food.

	Conclusion: Through the analysis of the functional characteristics of freeze-dried passion fruit pulp, it was observed that the number of total polyphenols presented medium values and the antioxidant capacity high values, which can be potentially transferred to the fermented beverage.
Shigla (2021)	**Subject:** Drying of arazá (Eugenia stipitata) pulp in a pilot plant dryer by the atomization method. **Objective: To** determine the appropriate conditions of temperature, flow and concentration of soluble solids to obtain powder from the pulp of arazá by spray drying. **Keywords**: Arazá, spray drying, temperature. **Conclusion:** The best conditions for the drying process are: Soluble solids concentration of 12 ºBrix (10.4 % w/w maltodextrin/juice), an air inlet temperature of 150ºC and a feed flow rate 2.20 L/h (pump speed: 20 rpm), At these conditions a product with a moisture content of 2.24% is obtained.
Barreto (2021)	**Subject**: Evaluation of the loss of vitamin C and polyphenols in the osmodeshydration of kiwifruit (actnidiachinensis) in an infusion with moringa (moringa oleifera). **Objective**: To evaluate the loss of vitamin C and polyphenols in the osmodeshydration of kiwifruit (Actnidia chinensis) infusion with moringa (Moringa oleifera). **Keywords**: Antioxidant activity, osmodeshydration, polyphenols. **Conclusion**: The application of osmodeshydration and convective drying to kiwifruit enriched with moringa reduced the loss of nutrients without affecting its sensory attributes.
Borbor et al. (2021)	**Subject:** Preparation of a freeze-dried product from red pitahaya pulp. **Objective**: To develop a freeze-dried product with a high nutritional value from red pitahaya (Hylocereus undatus), to add value to the raw material unsuitable for export. **Keywords**: red pitahaya, freeze-drying, milling. **Conclusion**: Rapid freezing through the use of liquid nitrogen of the raw material helped us to avoid the production of humidity and the formation of large ice crystals in the raw material, alterations in the properties of the food, in addition to avoiding the proliferation of altering and pathogenic microorganisms.
Quijije (2021)	**Subject:** Study quality parameters and sensory characteristics of red pitahaya (Hylocereus undatus) and yellow pitahaya (Selenicereus megalanthus) for their application in agroindustrial processes. **Objective**: To study the quality parameters and sensory characteristics of two varieties of pitahaya: pink pitahaya (Hylocereus undatus) and yellow pitahaya (Selenicereus megalanthus), for their subsequent application in agroindustrial processes. **Keywords**: Quality parameters, sensory characteristics, pitahaya. **Conclusion**: The sensory evaluation of the freeze-drying process of pitahaya, using statistical analysis, determined that, in general, the best scoring treatments of the evaluated aspects were: (yellow pitahaya + degree of physiological maturity) (yellow pitahaya + degree of commercial maturity).
Moran (2021)	**Subject**: Effect of chemical peeling as a pretreatment in the dehydration of uvilla (Physalis peruviana L.). **Objective**: To apply chemical peeling as a pretreatment in the dehydration process of uvilla (Physalis peruviana L.). **Keywords**: Grapefruit, chemical peeling, sodium hydroxide.

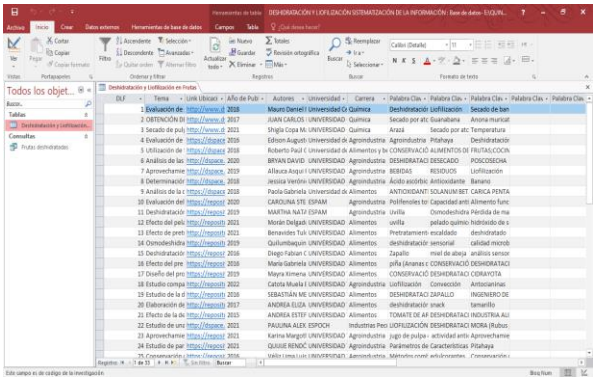
	Conclusion: The use of pretreatment (chemical peeling) in the grapefruit optimized the dehydration process and helped improve the product's texture, being accepted by the panelists with a rating of **"Pleasant."**
Benavides (2021)	**Subject**: Effect of pretreatment (blanching) on dehydration of pineapple (Ananas comosus) variety Sweet Golden or MD2. **Objective**: To evaluate the effect of blanching as a thermal pretreatment in the dehydration process of pineapple (Ananas comosus) variety Sweet Golden or MD2. **Keywords**: Pretreatment, blanching, dehydration. **Conclusion:** The physicochemical parameters such as pH obtained a value of 3.66, different from the NTE INEN 1836 standard due to the degree of maturity of the pineapple and the biochemical changes that occur during the ripening process, for the titratable acidity and soluble solids 9% and 15ºBrix respectively agree with the provisions of the standard above.
De la Cruz (2021)	**Subject:** Exploitation of the antioxidant capacity of cocoa (Theobroma cacao L.) pulp juice of clone CCNN-51 and national varieties (above) by spray drying. **Objective: To** evaluate cocoa pulp juice and its antioxidant capacity in cocoa varieties (Theobroma cacao L.) Clone CCN-51 and Nacional (Arriba) before and after spray drying. **Keywords**: cocoa pulp juice, antioxidant activity, utilization. **Conclusion**: The retention capacity of antioxidant activity after the drying process with and without added solutes (GA, CMC) in JPC-N and JPC-51 was found that the solids exert a protective effect on the functional compounds of JPC-N, JPCF-51P and JPCE-51P in a higher percentage.
Hiccup (2021)	**Subject:** Study of a mixture of sucrose plus freeze-dried blackberry (Rubus glaucus) for its application in the food industry. **Objective: To** gather information on studying sucrose plus freeze-dried blackberry mixture for application in the food industry. **Keywords**: Lyophilization, dehydration, blackberry (Rubus glaucus). **Conclusion:** Freeze-drying is a good method of food preservation, which improves the quality of these, and through which we can contribute more to the nutrition of consumers, avoiding the use of additives where this method avoids the dragging of the aromatic oils of the food keeping the flavor, smell, vitamins and minerals intact.
Lopez (2021)	**Subject:** Efficacy of three dehydration methods in mandarin (pokan) to obtain dehydrated snacks. **Objective**: To evaluate the efficacy of three methods by dehydration in mandarin (Pokan), to obtain dehydrated snacks. **Keywords**: Dehydration, Brix, sensory. **Conclusion:** The most effective method to dehydrate mandarins is the electric method because it preserves their weight, color, flavor and shape characteristics for 15 days, this is because the electric dehydrator allows working with a temperature of 71C° with constant hot air flow in a time of 24 hours, allowing to have homogeneous dehydration.
Catota et al. (2022)	**Subject**: Comparative study between convection drying and freeze-drying process in producing mortiño powder (Vaccinium floribundum kunth). **Objective**: To perform a comparative study of the effect of variables (drying methods and times) on the quality of a dehydrated powder of mortiño (Vaccinium floribundum kunth). **Keywords:** Freeze-drying, convection, anthocyanins.

	Conclusion: The convection drying method significantly influences the number of anthocyanins; however, the freeze-drying method, which involves freezing and sublimation, allows the elimination of water and the preservation of anthocyanins. This method favored the identification of the best treatment for obtaining mortiño powder.
Asqui et al. (2022)	**Subject:** Effects of freeze-drying on the antioxidant activity of arazá (eugenia stipitata McVaugh). **Objective**: To analyze the effects of freeze-drying on the antioxidant activity of Arazá (Eugenia stipitata McVaugh). **Keywords**: Araza, antioxidant activity, freeze-drying. **Conclusion:** Freeze-drying in terms of antioxidant activity reported significant differences in the percentage of radical inhibition. On the other hand, according to bibliographic research, the second method with the best results is the freezing process. The freeze-drying process allowed for obtaining freeze-dried powders with acceptable physical stability (during the first 48 hours at a temperature of 22.05°C) and a functional contribution of healthy compounds.

Source: Salazar, Q. 2022

Table 3 shows the analysis of the most important aspects extracted from all the undergraduate papers compiled in the DSpace of the universities of Ecuador. All the papers in themselves conserve and take advantage of the fruits grown in the country, applying conservation methods to prolong the shelf life of the food more technically, offering the consumer a safe and quality product that maintains or enhances its nutritional and organoleptic properties. To prepare the table, the following aspects were taken into account: author and year of publication, the topic of the degree work, objective, keywords and conclusions.

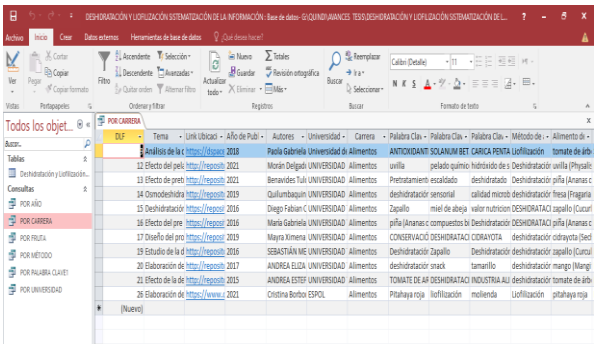
Figure 4. Systematized information or database.



Source: Salazar, Q. 2022

Illustration 4 shows the Microsoft Access program with the information collected from the Dspace of the universities of Ecuador on dehydration and freeze-drying of fruits, with the 33 theses already entered, and as can be seen, the database has already been created according to the parameters and/or fields that were established (code, subject, link, year of publication, author, university, career, keywords and summary).

Figure 5. Query method.



Source: Salazar, Q. 2022

Figure 5 also shows a database by queries, which are ways or methods in which the user or student can access information on dehydration and freeze-drying of fruits by year, career, method, fruit, university, and keyword.

Figure 6. Consultation method

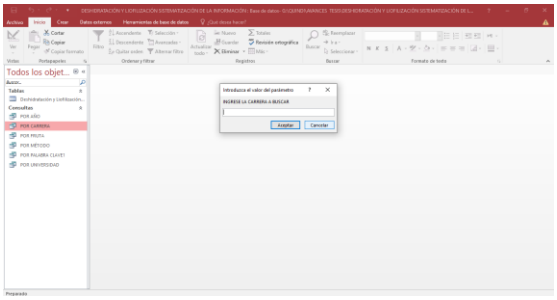


Figure 6 shows a window that appears when double-clicking on the search criteria by career and entering it, as shown in Figure 5. So, for example, the studies develop in the food career since that was the one that was typed.

Discussion

Systematization of information is one of the actions in which a series of processes, order and a purpose are involved, where the aim is to present information or a clear work where the user has that ease of learning and handling the same, the same manifest (Ramos et al., 2016, p.16) expressing that systematization is born from the idea of system, order or classification of different elements that are governed by a similar rule or parameter. For this reason, systematization is an order whose purpose is to achieve positive results following the stated purpose. Therefore, systematization can be used in the scientific and academic fields and applied during any moment of our lives according to the needs. Whereas Jara (2020) states that in addition to an educational approach in general and other types of social work, systematization is applied not only with data or information that is collected and organized. It is more than that, referring to "obtaining critical learning from our experiences."

Dehydration, a method of food preservation through hot air, is one of the oldest forms of food preservation, allowing the reduction of water contained inside the food and thus preventing the growth of microorganisms (Espinosa, 2016, cited in Cabascango, 2018). The same mentions (De Michelis et al., 2015) that dehydration comprises eliminating water by treating the product with artificial heat.

Freeze-drying is one of the food preservation methods where it does not affect the integrity or the initial structure of the product due to sublimation and the use of low temperatures so that the volatile components are not lost during the process (PortalFruticola, 2016). Corroborating with (Chavarrías, 2010) which states the following, freeze-drying is a method of food preservation involving several processes, which consists of removing water from a food product by freezing instead of applying heat.

The sugar solution and temperature influence the antioxidant capacity of the compounds of fruit; as manifested by Bustos (2015), the degree of concentration of syrup or inverted sugar solution and the temperature used in osmo-dehydration, influences the antioxidant capacity for both yellow and purple tree tomato.

Similar to the previous case regarding the influence of osmotic dehydration on vitamin C loss in apples, it is due to the sweetener concentration and temperature, as expressed by (Marín, 2016) the sweetener concentration and even more, the temperature with which they worked since due to the change and increase of T° from 40 to 60 ° C accelerates the rate of dehydration and thus increases the gain of solids causing vitamin C to be lost.

CONCLUSIONS

- The study included the review of the degree works in the different Dspace or virtual libraries of the universities of Ecuador regarding dehydration and lyophilization in fruits, and a total of 33 works carried out in the different regions of Ecuador were compiled.
- Of the study carried out in the universities of Ecuador in terms of dehydration and freeze-drying in fruits, the careers of food

engineering, agroindustry and chemical engineering are the 3 careers that have carried out the most work with 11, 10 and 5 works each, respectively from 2015 to 2022.

- In the different universities of Ecuador, work is done in dehydration and freeze-drying in fruits, and per year the universities publish their research, therefore according to the present work of curricular integration, in the year 2021, 9 publications were made, in 2016 and 2019 6 works were published in each year, and 5 works in 2018, these are the years that more publications have been made concerning dehydration and freeze-drying in fruits.

- The universities in Ecuador that carry out the most work in dehydration and freeze-drying in fruits are the Agrarian University of Ecuador, with 5 publications, while the UNACH, Carchi State Polytechnic University, Technical University of Ambato, Equinoccial Technical University and the State Technical University of Quevedo with 3 publications each in the period from 2015 to 2022.

- A table was developed to show and analyze each degree work's most important points and aspects. Although, dehydration and freeze-drying are very beneficial methods to preserve and prolong the shelf life of foods, in the case fruits, since they are perishable products and are exposed to the environment and therefore to contamination, it is very necessary to apply a method or conservation process to maintain the nutritional and organoleptic properties, to take advantage of them in the best way, whether as candies, energy bars, snacks, beverages, etc.

- Based on the information gathered, a database was created with the help of the Access program, where in order to systematize, the following fields were taken into account: code, subject, link, author, university, keywords and summary, for easy access and management for students of different academic levels. Furthermore, at the same time, it will serve as a reference tool for future research.

RECOMMENDATIONS

- Improve knowledge in Microsoft Access or other programs to create or develop better databases to make the information easier to use.

- The fields to systematize the information or create the database should be specific and be clear according to the subject for ease of data management.

- Search for alternatives in applications or programs to create databases such as Excel to provide the user or student with quality information through figures, graphs or tables.

- Search for other fields of agribusiness to systematize since there is loose information on the web that needs to be analyzed and thus taken advantage of by students and teachers of different academic levels.

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