2014中国（大连）第三届世界海洋大会论文集

The Proceedings of 3rd World Congress of Ocean 2014

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Chief Editor　Zhang Yu

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Preface

The Organizing Committee of the 3rd World Congress of Ocean 2014 has the honor to publish a compilation on marine science. This is a collection of theses on the frontier-study in the field of ocean science, current and potential applications in marine engineering, technology, management, and business hunting, which concludes systematically overall views of how to unveil the mysteries of the ocean, arousing people's curiosity from discovering more secrets of nature. It presents a summary of substantial basic knowledge, touches the forefront development and thereupon will attract sustainable research and development in relevant field.

Any more, it is in the promotion of national prosperity and responsibility driven by human harmony. We complete this compilation in order to help the public, especially the young to broaden their minds, enrich their knowledge on the ocean and correct their cognition. Hence, we encourage the young to have the courage that "we would contribute to the ocean industry and the progress of mankind."

The materials of this collection is apart from the contributions of the Organizing Committee, based on a number of sources, which reflects work by many staff and students from Dalian Ocean University and other Maritime Universities over a period of months while collaboration together on conception of the ideas, theme sheets and content-reviewing.

We would like to express our most heartfelt gratitude to all the authors of these

excellent academic papers that we have received, the cooperators who have assisted in adapting this book, and the evaluation committee which has seen the endeavor of the professors and renowned scholars.

Nevertheless, the collection is limited in its scope because of extensive areas in ocean study, and there must be mistakes as well as missing points that we can hardly avoid. Your comments are highly appreciated!

The Organizing Committee of 3rd World Congress of Ocean, 2014

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Dehydration and Protein Retention of Starfish by Different Drying Approaches

Zhang Guochen, Li Sha, Yu Peng, Zhang Qian, Huo Jin

(R & D Center of Fisheries Equipment and Engineering of Liaoning Province, Dalian Ocean University, China)

Abstract: In order to increase the efficient utilization of starfish, the effects of different drying methods (microwave vacuum drying, oven drying, vacuum drying and far-infrared drying) on drying time, drying rate, energy consumption and protein retention rate of starfish skins were investigated. Results indicated that the microwave vacuum drying was much faster than other drying methods for only 16 min was needed and the drying rate could reach to 4.32%/min. Furthermore, lesser energy consumption and higher protein retention rate could be obtained by microwave vacuum drying, namely 0.012 kW·h/g and 94.21%. In contrast, the drying rate was lowest and the energy consumption was highest with oven drying, namely 3.36%, 6.05 times of microwave vacuum drying, respectively. Lowest protein retention rate of 65.46% were obtained by far-infrared drying, namely 69.48% of microwave vacuum drying.

Keywords: starfish, microwave vacuum drying, oven drying, vacuum drying, far-infrared drying

1 Introduction

Starfish is widely distributed in inshore aquaculture zones in China and it is the predator for many aquaculture animals such as oysters, scallops and abalones, etc. Due to strong fecundity and regenerative capacity, the annual yield of starfish reaches to 50,000 tons in DaLian which seriously imperils the development of aquaculture industry. On the other hand, Starfish is rich in nutrients and the protein content of starfish is up to 28.9%. Therefore, it is potential resource for food and feed processing industries, etc. Unfortunately, starfish is generally thrown away as waste or few are utilized as fertilizer. It has been demonstrated that dried starfish powder could be used as protein additive for feed processing and achieved good feeding effects. However, as traditional drying method such as natural drying is often used in starfish processing industries, sanitary and

product quality of dried starfish are still problem.

To increase the drying rate, reduce energy consumption and reserve nutrients, microwave vacuum drying, oven drying, vacuum drying and far-infrared drying of starfish skins were carried out. Optimal drying approach of starfish skins is suggested for the efficient utilization of starfish.

2 Materials and methods

2.1 Materials and equipment

2.1.1 Materials

The starfish were collected in May from the coast of Dalian Heishijiao. Fresh starfish were washed and cleaned firstly. Gonad and stomachs were removed and skins were cleaned up. The skins were preserved at –20℃ in a freezer.

2.1.2 Equipment

The equipment used in this study include a microwave vacuum dryer (MZ08S-1A, Nanjing Huiyan Microwave Equipment Co. Ltd., NanJing, China), a far-infrared dryer (YHG-400-S-II, Shanghai Yuejin Equipment Co. Ltd., Shanghai, China), a vacuum dryer (DZF, Shanghai Yuejin Equipment Co. Ltd., Shanghai, China), an oven dryer (101A-3, Shanghai Test Equipment Co. Ltd., Shanghai, China) and an electronic balance (MP1100B, Shanghai Hengping Science Instrument Co. Ltd., Shanghai, China).

2.2 Test method

2.2.1 Drying methods

Microwave vacuum drying: 100 g starfish skins were put tidily on a plate in the chamber of microwave vacuum dryer and dehydrated until the sample reached the final moisture content (13% w.b.) by control the microwave power density and vacuum degree at 4 w/g and 90 kPa, respectively. Weigh the sample every 2 minutes by the balance during the drying process.

Vacuum drying: 100 g starfish skins were put tidily on a mash in the chamber of vacuum dryer and dehydrated until the sample reached the final moisture content (13% w.b.) by control the vacuum degree and the temperature at 90 kPa and 60℃, respectively. Weigh the sample every 1 hour by the balance during the drying process.

Far-infrared drying: 100 g starfish skins were put tidily on a mash in the chamber of far-infrared dryer and dehydrated until the sample reached the final moisture content (13% w.b.) by control the temperature at 60℃. Weigh the sample every 1 hour by the balance during the drying process.

Oven drying: 100 g starfish skins were put tidily on a plate in the chamber of oven dryer and

dehydrated until the sample reached the final moisture content (13% w.b.) by control the temperature at 60℃. Weigh the sample every 1 hour by the balance during the drying process.

2.2.2 Calculation and analysis methods

Moisture content: The moisture content of starfish sample was measured by the *National Standard Method for Determination of Moisture in Foods* (GB/T 5009.3–2003).

Energy consumption: The energy consumption (kW·h/g) during drying process was the energy required for drying per gram of water.

Protein content: The crude protein content of starfish sample was measured by the method listed in GB/T 5009.3–2003.

3 Results and discussions

3.1 Effects of different drying methods on drying rate

Effects of different drying methods on drying time were shown in Fig. 1. The drying time needed for starfish to be dehydrated to the moisture content of 13% were significantly different among oven drying, vacuum drying, far-infrared drying and microwave vacuum drying. Only 16min was needed for microwave vacuum drying, while oven drying, vacuum drying and far-infrared drying needed 540 min, 400 min and 390 min, respectively, namely 33.75 times, 25 times and 24.38 times of microwave vacuum drying.

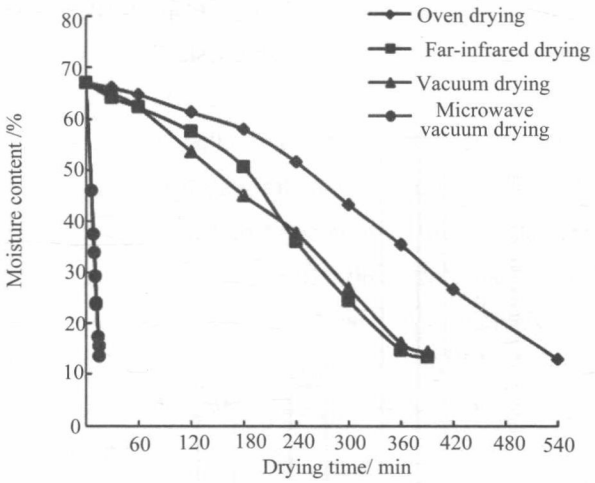

Fig. 1 Drying curves of starfish under different drying approaches

The drying rate of starfish with different drying methods was shown in Fig. 2. It is clear that the drying rate of microwave vacuum drying could reach to 4.32%/min while oven drying, vacuum drying and far-infrared drying were 0.15%/min, 0.18%/min and 0.24%/min, respectively,

namely 3.36%, 4.18% and 5.62% of microwave vacuum drying. It attributes to the combination of rapid heating and vacuum conditions of microwave which could accelerate water evaporation during microwave vacuum drying.

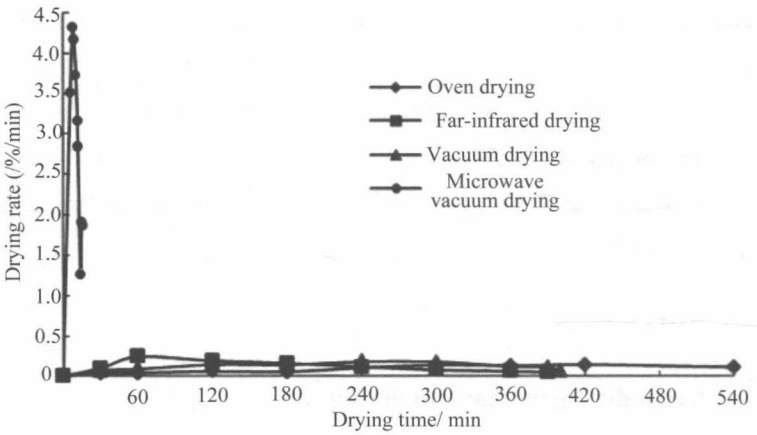

Fig. 2 Drying rate of starfish under different drying approaches

3.2 Energy consumption of different drying methods

Energy consumption for drying starfish to drying terminal point under different approaches was shown in Fig. 3. It was obviously that the energy consumption was lowest with microwave vacuum drying, while oven drying, vacuum drying and far-infrared drying were 6.05 times, 1.7 times and 1.99 times of microwave vacuum drying, respectively. Consequently, the energy conversion rate of microwave vacuum drying is the highest.

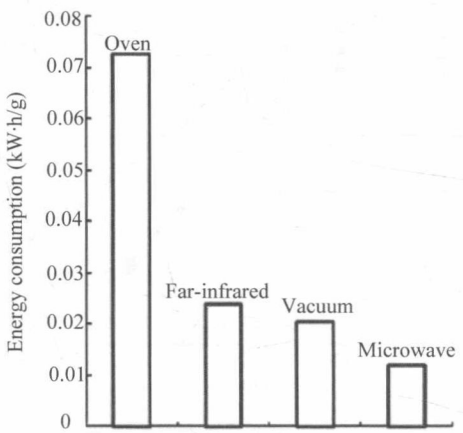

Fig. 3 Energy consumption of different drying methods

3.3 Protein retention rate with different drying methods

It was demonstrated in Fig. 4 that the protein retention rate of starfish by microwave vacuum drying, vacuum drying, oven drying and far-infrared drying were 94.21%, 83.17%, 73.93% and 65.46%, respectively. Results indicate that the protein content of starfish with different drying methods were decreased compared with fresh starfish due to protein denaturation was occurred during drying process. However, higher protein retention rate could be obtained by microwave vacuum drying. That attributed to the lower dry temperate and shorter dry time.

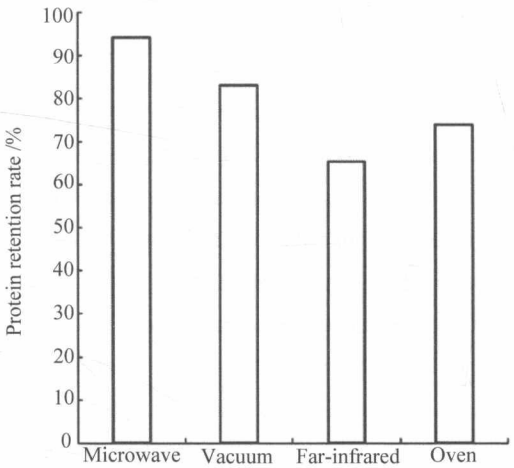

Fig.4 Protein retention rate by different drying methods

4 Conclusions

The effects of different drying methods on drying rate, energy consumption and protein retention rate were different. Highest drying rate and shortest drying time could be obtained by microwave vacuum drying, namely 4.32%/min and 16 min. In contrast, the drying rate and drying time of oven drying were 0.15%/min and 540 min, respectively. Furthermore, the energy consumption of starfish by microwave vacuum drying was relatively lower than other drying methods and was only 16.52% of energy cost by oven drying. Meanwhile, dried starfish by microwave vacuum drying had the highest protein retention rate of 94.21% and far-infrared drying had the lowest protein retention rate of 65.46%. Generally, microwave vacuum drying is an alternative drying method for starfish processing industry because of shorter drying time, higher drying rate, lower energy consumption and higher protein retention rate.

[Biography]

Prof. Zhang Guochen received his Ph.D. at China Agricultural University, on studies the agricultural product processing and storage engineering. He works at Dalian Ocean University as the head of Fisheries Engineering Institute and vice-president of Dalian Ocean University. He is supervisor in the field of agricultural mechanical engineering and aquatic product processing and storage engineering. He has more than 30 publications related to aquatic product processing machinery and automation control technology.

The Structure and Functions of ECS for Enhancing Safety and Surveillance of Small Ships

Juhwan Lee

(Vice President / Head of R&D, GMT Co., Ltd., Republic of Korea)

Abstract: Recently, e-navigation for the enhancement of vessel safety and effective monitoring of vessels in maritime domain has become a hot topic in the world. E-navigation, which facilitates more effective management and operation for vessel safety, intelligent service, automation, efficient surveillance, and systematization through electronic devices, is a wind of change in the field of maritime safety and security. In spite of these changes, most attention is getting on large vessels which make long international voyage. Various communication equipment and systems have been developed and introduced for the large vessels so far. However, it is the undeniable reality that marine communication equipment for small vessels has not come into wide use due to its high price in comparison with the performance of the research and development for the small vessels. In this study, I recognized the problems with such an issue that I conducted the research for small vessels, especially for ways to improve voyage safety of fishing vessels and efficiency for vessel monitoring, in terms of structural aspect and functional aspect of ECS respectively. Furthermore, the study was focused on function and structure of ECS which can be used as a navigation device in daily life and support search and rescue works after issuing early warnings in case of emergency situation. Also, study on cost reduction of the ECS unit has been done. I am planning to apply the outcomes from the additional research to vessels and improve more reliability for the equipment after performing sufficient tests and adjusting sensors.

[Biography]

Dr. Juhwan Lee, Head of GMT R&BD center, received a M.Sc in signal processing from the University Hanyang and a Ph.D. from the University of Hansei. More than 18 years of professional experiences in various fields such as basic research on electronic navigation, marine communication, and signal processing for safety and security. Dr. Juhwan Lee began his career as a researcher at the software R&D Center of Samsung electronics for software engineering in 1994, and held research positions for signal