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The use of new generation sequencing technologies for aquaculture genetics studies

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Abstract

The new generation sequencing is a novel biotechnological method that has been used in versatile fields. In this study, we are sharing the latest literature in aquaculture field and how the new generation sequencing can be utilized to increase the efficiency in production. Aquaculture technologies are older than terrestrial animal production technologies. It is almost a necessity today to use high-tech biotechnological methods for a more sustainable and efficient operation of this sector, which occupies a very important place in the world's food needs. For this reason, we should start to manage the aquaculture production sector in a more controlled way by using new generation sequencing methods to decipher the genomes of the organisms and easily generate safe genetically modified or more resistant individuals.

Introduction

New generation sequencing technologies started in 1977. In the last 40 years, DNA sequencing methods have developed through many different stages and has progressed by expanding its sequencing capacity. If we look at the place of new generation sequencing techniques in aquaculture production; the use of gene sequencing has made it possible for the characterization and mapping of genes, population genetics, ecological speciation, genomic evaluation, sex control and determination, quantitative research to understand the diseases, and the use of biomarkers. In addition, with the advent of NGS technologies, the discovery of multiple types of high- throughput variants have become possible. NGS is considered a highly efficient, reliable and inexpensive method to achieve the abundant genetic diversity of organisms [1,2]. Through NGS, we can pinpoint the reason behind the disease susceptibility and decrease in the production efficiency at the genetic level. This method enables more knowledge on the genes that play essential roles in these processes and how to overcome these hurdles to increase the production efficiency either by targeting certain gene products specifically or by altering the genes to get genetically modified organisms with higher production efficiencies during aquaculture applications [1, 2].

Results

Aquaculture is the fastest growing fresh food sector. For this reason, aquaculture must be sustainable. Direct genotyping with the help of NGS is known as GBS. Genotyping can be done with in the genome in aquaculture with GBS [1]. It is a method preferred by companies for small research types without GBS model. The discovery of GBS has revolutionized genome-wide studies by speeding up certain steps [2]. This revolution has affected aquaculture in terms of genetic mapping of species and improving the production efficiencies by genetic selection methods. In particular, it is used with the DNA sequencing method (RAD-seq), which works with the restriction region logic. RAD-seq contains DNA sequencing of the reduced versions of the examined genome and are restriction-based

libraries [3]. If we look at where RAD-seq techniques are used; it can be used in the creation of genomic maps, editing and debugging of the genomes, sex determination in aquaculture, creating disease resistance and growth in the individuals. At the same time, it is important to understand the development of health biomarkers to prevent viral bacteriological diseases that cause huge losses to fish farming industries globally. Reliable marker technologies capable of genome wide screening are essential for the development of isogenic fish lines, and NGS provides this potential. With NGS, more reliable markers with a lower error rate are prepared with a much faster pace. With these developments, tens of thousands of markers for aquatic species can be prepared quickly. This also prepared the ground for proving previously untested hypotheses. If we look at where these technologies can be used in aquaculture production and what benefits they can provide; we can say the creation of genomic maps that can be reference, the creation of population genetics, its use in verification and validation studies, the possibility of sustainable and environmentally friendly production, the genotyping of fish for breeding purposes, the determination of sex maps to increase the efficiency of production. If we examine what some of the researches made with the aquatic species whose reference genome maps were created; genetic markers associated with the disease resistance of *Flavobacterium psychrophilum* and infectious hematopoietic necrosis virus (IHNV) disease have been identified on rainbow trout and they used these markers (marker assisted selection) to establish improving populations resistant to the diseases mentioned above. Thus, viral and bacteriological diseases are prevented and major damages that may occur in the production are prevented. In another study, markers close to the Atlantic halibut sex determination regions were determined. Functional males were determined with these markers, and then all female populations needed by the industry were created. In this study, sex determination and yield increasing properties of NGS on aquaculture were used. In some studies, it is used in improving programs used in high throughput genotyping studies with the help of chips named according to the number of markers to determine the level of polymorphisms for different populations. Among the species used in studies using these chips; we can give examples of channel catfish, rainbow trout, Atlantic salmon. If we look at the research and studies on the environment for aquaculture and genetics, the fish were monitored with the TNP markers made with the RAD-seq on sturgeon fish and studies were carried out to protect them with these inferences. In general, when we look at these studies, we can see the benefits of using NPP in academic research, economic studies and minimizing the damage to the environment. If we want to create more productive aquatic cultures, we must base our cultures on selective breeding programs. As in the case of the terrestrial animal production, aquaculture has an important place in the world's food needs [1]. Direct genotyping with the help of NGS is known as GBS. Genotyping within the genome can be done in aquaculture with GBS [2]. It is a method that can be preferred by companies for small scale research set up that do not have the GBS model. The discovery of GBS has revolutionized genome-wide studies by accelerating certain steps during the process [3]. This revolution has affected the aquaculture in terms of the genetic mapping of the species and improving the yield studies. In particular, it is used with the DNA sequencing method (RAD-seq), which works with restriction region logic. If we look at where RAD-seq techniques are used; it can be used in the creation of genomic maps, editing, and debugging of genome studies, sex determination in aquaculture, establishing disease resistance and improved growth.

Discussion

Overall, it has been concluded that NGS provides better and sustainable production of the aquaculture products through the knowledge-based advantages it provides with the high throughput genetic sequencing. There are many studies in this area to increase the information about the genes involved in the aquaculture product quality and quantity. In particular, using the RAD-seq sequencing method, one of the GBS techniques, has helped to produce modern fishery products by means of increased growth, sex determination and prevention of diseases. From this point of view, biotechnological methods have great potential in aquaculture [1-4]. More studies should be conducted in the field to further improve the sequencing quality and pace to further expand our knowledge for improved yield and product quality in aquaculture practices.

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