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Techniques to Produce Polyploidy Species in Aquaculture: A Review

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Abstract

Aquaculture stability is one of the best ways to produce the source of protein from animals while using the least amount of grain possible, and it has proven to make a significant come up to global security of food and nutrition for human being. The aquaculture industry's major purpose is to increase output of fish and other aquatic products since the current product are not sufficient to meet the demand. Polyploids have three or more complicated sets of chromosomes (genomes). Fish have a higher rate of polyploidy than other animals. Heat shock, cold shock, pressure shock, chromosomal modification, sex control, and hybridization are some of the procedures used to produce polyploidy. This study is to analyze polyploidy and ploidy manipulation products and potential polyploidy threats in the future, the efficiency or the method and the benefit of polyploidy. Cold shock has the highest survival rate, with a 98.7% success rate, according to studies. This review has been conducted with a large quantity of information was gathered from a range of sources, including books, websites, and online journals, all of which provide accurate information on aquaculture polyploidy procedures. Polyploidy has numerous advantages, including increased aquaculture production, increased growth rate, and the creation of sterile animals. Polyploidy's downsides include the disruptive effects of nuclear and cell enlargement, the inclination of polyploid mitosis and meiosis to produce aneuploidy cells, and epigenetic instability that leads to transgressive (non-additive) gene regulation. Physical and chemical therapies, on the other hand, are not the same as natural factors that can lead to aneuploidy. Despite the hazards and obstacles to the species and habitat, polyploidy products have a high possibility of commercialization.

Keyword: Polyploidy; aquaculture; techniques

INTRODUCTION

Polyploids are species with three or extra complex chromosome sets (genomes), and it is very likely in animals [1]. According to the study of Hox gene clusters and whole genomes, vertebrates underwent two rounds (2R) of whole genome replication (WGD) prior to the dividing of lamprey from jawed vertebrates, resulting in chromosome number of 48 (2N 1/4 48) in almost all diploid vertebrates [1]. Concurring to Can et al., (2012), there is mounting evidence that animals have substantial polyploidy

as well [2]. Zhan et al., (2014) has stated that polyploidy is more common in fish than in other animals. In the *Acipenseridae, Ostariophysi*, and, most prominently, the *Cyprinidae*, polyploid assemblages have been well known. Furthermore, the *Salmonidae* and *Catostomidae* families are believed to have had gene replication in their ancestors. The remarkably species-rich ray-finned fish descended from a polyploid progenitor, demonstrating potentially keen effect of polyploidy in fish evolution, according to genomic studies [3].

METHODOLOGY

All of the data was gathered using the data mining method. If the information and data were related to the research title and objectives, they were collected. Primary and secondary data were gathered for this investigation. Surveys, questionnaires, observations, experiments, and interviews were all used to acquire primary data. In the meantime, secondary data was obtained from books, journals, papers, online sites, and blogs. There is no overlap between primary and secondary data sources, and they are clearly distinct. Essential and auxiliary information were utilized in this examination, in spite of the fact that they were collected, handled, and dissected in different ways.

DATA COLLECTION

Data collection is the process of acquiring, measuring, and analyzing accurate insights for research objectives using established approved methodologies. Data might include numbers, information, knowledge, figures, descriptions, and measurements or observations of a set of variables. The information was taken from raw data from a previous study. The primary focus of this research was on Technique for Producing Polyploidy Species in Aquaculture. In addition, all of the data for this thesis evaluation was gathered from relevant journal papers, e-books, previous research, websites, and other trustworthy sources.

DATA ANALYSIS

In order to complete this review, a vast amount of data was gathered from a variety of outlets, including books, blogs, and online journals, all of which provide accurate information on the techniques for producing polyploidy in aquaculture.

EVALUATION OF INFORMATION

The results were compiled in order to detect and classify polyploidy in aquaculture. Readings and evaluations have been used as a strategy for summarizing data. All of the data has been compiled in order to complete this review.

DATA ANALYZING

Via analyzing and extracting close to their principles and procedures, many of the accumulated realities and knowledge have been analyzed. At that point, the ideas and documents were put to use in the development of this review paper.

STATISTIC INFORMATION

To justify this study objective, statistical data from related studies on techniques to generate polyploidy in aquaculture was studied and collected. By listing statistical analysis performed by researchers using different methods, a much more solid writing with objective evidence and explanations is possible, making this review writing more complete and justified.

RESULT AND DISCUSSION

Concurring to Glover et al., (2020)[4], the composite genotypes at 16 polymorphic microsatellite loci, no diploid offspring in Atlantic Salmon were identified among the 760 eggs or 1161 adolescents that

had been pressure-treated in a research done for hydrostatic pressure. The weight treatment's adequacy might not be decided adequately. This can be due to the truth that the 1219 diploid controls were raised within the same imitate tanks as the 1099 pressure-induced triploids, which seem lead to misidentifications as sketched out within the approach. In Hassan et al., (2018) examination, the preparation rates of the two gatherings of eggs were comparative (90%) [5]. Since the treatment were from comparable rearing stocks (Anabas testudineus) and the heat shocking was conveyed solely after preparation, this outcome was not startling. For the two diploids and triploids, the early cleavage phases of creating undeveloped organisms were generally mitotic discoidal meroblastic divisions set apart by a deficient cleavage that happened only in the animal shaft. It is salient that, regardless of the embryogenetic stages being comparative (for example past the 2-cell stage), the triploid eggs created undeniably more leisurely (15min to 5h later) than the diploid eggs. The three-minute warmth shock conveyed around four minutes after origination for the triploidization cycle is thought to have extraordinarily repressed organic cycles [5]. Table 1 shows the effectiveness of the techniques in producing polyploidy while Table 2 shows the effectiveness in triploid and diploid species.

Table 1 The effectiveness of the techniques in producing polyploidy

Techniques	Effectiveness	Reference
Hydrostatic pressure	Could not be adequately assessed	[4]
Chromosome manipulation	40% of control diploids	[6]
Cold shock	98.7% with 30-minute duration and 6°c-15°c temperature 76.5%–98.7% with 15 to 35-minute duration and 9 °C temperature	[7]
Heat shock	84.12% 40°C with a temperature 40°C and 4-minutes duration	[8]

Table 2 The effectiveness in triploid and diploid species

Triploid	Reference	Diploid	Reference
Develop slow in *Anabas testudineus*	[5]	No offspring were identified in Atlantic salmon	[4]
Well develop in common carp	[9]	Fast development in *Anabas testudineus*	[5]
Infrequent happen in Atlantic salmon, and Atlantic cod	[10]	Develop slower in Dojo loach	[6]

Polyploidy was recently distinguished utilizing a couple morphological, cytological, and hereditary measures. Be that as it may, portraying polyploidy just on the above underlying premise may not be exact in light of the fact that chromosomal matching conduct is additionally impacted by different components [11]. Then Sato et al., (2020) [12] used silver nitrate staining to look for indirect cytogenetic markers for triploidy detection on chromosomes with nucleolus organiser regions (NOR). In this situation, the NOR number in the interphase nucleus might be used to determine the number of chromosomal sets (ploidy level) in individuals subjected to triploidization, as several fish species have been. Table 3 shows the summarized method for polyploidy detection.

Table 3 Summarized method for polyploidy detection

Method	Reference
Reassociation kinetic Biochemical analysis	[11]
Silver nitrate staining	[12]
Erythrocyte nuclear size comparison	[13]

CONCLUSION

In conclusion, polyploidy gives much benefits in aquaculture industry and it requires a lot more innovation for the industry to evolve. Out of all the method mentioned above, cold shock has shown the highest rate of effectiveness and easy to conduct. Many challenges in producing polyploidy were also found and ways to overcome it will continuously be discovered. Polyploidy products has soaring chances to be commercialize despite of its threats and difficulties to the species and environment. More researcher should be hired in conducting more studies in polyploidy and new technology should be used to concomitantly be with the new era. Research on new technique or upgraded technique will incessantly carry out. More involvement of safe chemical and physical should be implied.

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