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PRODUCTION OF DIFFERENT FISHES BY USING FAMILIAR AND UNUSUAL RAW MATERIALS

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Abstract
Japanese aquaculture sector has been losing former momentum and now the entire industry is slugging and enters the declining period. The main causes of depression are slugging demand and long-term price decline. Now, Japanese aquaculture sector has become an unprofitable business. Therefore, the industry has been trying various efforts to escape the critical situation. The examples introduced in the present report is a practical model of production of different fish species by using familiar and unusual raw materials such as residues and by-products of the food industry.

Keywords: Japanese aquaculture, fish production, high value fish, raw materials, fish diets

Introduction
In the past, Japan was one of the advanced countries in aquaculture around the world, but lately it has been in a slump situation. The quantity (tons) between years 1975 and 2020 for the main 4 fish species dominating Japanese aquaculture sector has been illustrated in Table 1. Especially, the yields in land aquaculture have been decreasing to 36% level from its peak recorded in 1985 (Table 1, 1985 max to 2020, by 33%), while the yields in the Marine aquaculture sector have been stagnant over the last 2 decades (Table 2). The production of Bluefin tuna and silver salmon showed an increasing trend in general, however the production of other main fishes is drastically decreasing (Table 2, 1995 max to 2020, by 94%).

Table 1. Production of the main freshwater aquaculture fishes in Japan (FAO, 2022)

Inland aquaculture production (ton)					
Year	Total Production (main 4 sp.)	Trout	Ayu sweetfish	Carp	Japanese eel
1975	71,000	16,700	4,500	28,100	21,700
1985 (max)	**88,937**	**19,297**	**10,967**	**19,105**	**39,568**
1995	70,999	17,596	10,896	13,376	29,131
2005	41,599	11,732	6,527	3,845	19,495
2015	36,138	7,709	5,084	3,256	20,119
2016	35,027	7,806	5,183	3,131	18,907
2017	36,686	7,639	5,053	3,015	20,979
2018	29,695	7,342	4,310	2,932	15,111
2019	31,202	7,336	4,067	2,726	17,073
2020	28,900	5,900	4,000	2,200	16,800
1985-2020 (%)	*33*	*31*	*37*	*12*	*43*

Table 2. Production of the main marine aquaculture fishes in Japan (FAO, 2022)

Marine aquaculture production (ton)					
Year	Total Production (main 4 sp.)	Silver salmon	Japanese amberjack (Yellow tail)	Red seabream	Pacific Bluefin tuna
1975	96,700	0	92,400	4,300	NA
1985	186,381	6,990	150,961	28,430	NA
1986	186,908	7,533	145,878	33,497	NA
1995 (max)	**254,500**	**13,500**	**168,800**	**72,200**	NA
2005	248,500	12,700	159,700	76,100	NA
2015	232,659	13,937	140,292	63,605	**14,825**
2016	234,454	13,208	140,868	66,965	13,413
2017	233,355	15,648	138,999	62,850	15,858
2018	234,659	18,053	138,229	60,736	17,641
2019	233,100	15,900	135,600	62,000	19,600
2020	239,400	17,300	137,500	66,000	18,600
1985-2020 (%)	*94*	*128*	*82*	*91*	*NA*
2015-2020 (%)	-	-	-	-	*126*

NA: not available

The main problem which might have influenced Japanese aquaculture over the past years, such as economy, changes in eating habits, or remarkable decrease of the population, are problems related to internal common issues of Japan. However, there are also other challenges for the Japanese fish production sector. Originally, the fish species produced in the Japanese aquaculture are mainly luxury fishes, which have high value in the market. However, the market of luxury fishes is very small compared to daily foods like milk or egg. So, slight over production of luxury fishes led to a drop in price. By repeating this phenomenon, many aquaculture farmers fall into the red and closed their business. Unfortunately, the aquaculture in Japan has become an unprofitable business.

Under these circumstances, main aquaculture production areas are making management efforts in order to remain survivor. Following is one of their efforts called "Producing differentiated fish." Japanese aquaculture sector started in the 1960's. The backgrounds of the aquaculture's development were supported by following three essential elements. Namely;

1) "Establishment of seeds (young fish for aquaculture) production technology",
2) "Improvement of keeping and raising management technology"

As a result, it was possible to make a base ready for mass production. At that time, the target of the fish species produced were expensive and luxury fishes for Japanese people who love fish such as "Red seabream, Japanese amberjack (Yellow tail) and Flat fish", for example. Naturally, those produced fishes were traded at high prices in the market. Therefore, the aquaculture had become active, and many new fish farmers entered the business. As a natural result, the industry-wide fell into overproduction and many fish farmers fell into slumping business by decline in fish prices as the deterioration in the supply-demand balance. Consequently, many aquaculture farmers challenged severe economic problems and were forced to stop their business. So, it's said that the present fish farmers in Japan are survivors through the long structural recession, and they are still facing inter-aquaculture competition to keep their markets. Therefore, the Japanese aquaculture is challenging severe problems with high efforts and combat for survival in their business, with the main target of "Producing different fishes by using familiar and unusual materials".

Mainly, materials to produce different fish are food processing residue or by-products and these materials have common four important points as follows:

a. Materials must be safe for humans and fishes
b. Material prices should be cheap and cost-effective
c. The working load should be easy and labor costs should be reasonable
d. The produced fishes should be distinguished from conventional products.

Concrete example of producing different fish and the explanation of materials used:
This time, practical materials illustrated for the production of different fish can be divided in 5 items as below:

Citrus peel

This is the squeezed residue during orange juice manufacturing. This material is called Citrus peel or Citrus pulp, and the main sources are mandarin, orange and lemon. The material is added to the moist pellet or dry pellet's compound before processing. Addition rate is about 10% to make moist pellet and about 1% to make dry pellet. The material feeding term is almost 2-3 months before the harvest. The addition of Citrus spp. peels in diets of fish has been reported to improve growth performance and immune response, and also showed benefits in the challenge with bacterial diseases (Dawood et al., 2021; Dawood et al., 2022). This was also underlined for Mozambique tilapia (*Oreochromis mossambicus*) in the challenge against *Edwardsiella tarda* (Baba et al., 2016). *Edwardsiella tarda* (Baba et al., 2016). The target fishes were three species as Japanese amberjack (yellow tail), Red seabream, and Flat fish. The confirmed effects were as follows:

i. Relaxation of fishy smell (masking effect by citric flavor)
ii. Prevention of lipid surplus
iii. Prevention of red muscle browning (keep fish freshness)
iv. Improvement of texture

It has to be noted that, Citrus flavor clings to fish's edible portion. It is said that almost all Japanese consumer loves this smell, but minority of consumers disliked.

Green tea powder
This material is got at green tea sifting process. Usually, while the high-grade powder is used to beverages, low grade one is applied to the material. The material is added to the moist pellet or dry pellet's compound before processing. Addition rate is about 1% in compound. The material feeding term is through all year. The incorporation of green tea has been investigated in grass carp (*Ctenopharyngodon idellus*), and it was found that green tea was provided positive effects on health status of carp fish with improved growth performance (Zhou et al., 2016). The target fishes were three species as Rainbow trout, silver salmon, and Ayu (sweetfish)". The confirmed effects were as follows:

i. Reduced fishy smell (no masking effect)
ii. Prevention of lipid surplus
iii. Prevention of red muscle browning (Keep fish freshness)
iv Improvement of texture

In an earlier investigation, I used green tea powder in fish diets on a commercial base Rainbow trout and Ayu cultivating facility, and obtained clear results as those mentioned above (unpublished data). Turkey, India and China as a worldwide tea producing country, could benefit from tea leaves in fish feed manufacturing, as a valuable and domestically available raw material.

Powder olive leaves
This material is made from dried and crashed olive leaves. The material is added to the moist pellet or dry pellet's compound before processing. Addition rate is about 2% in compound. The material feeding term is about 20 days before the harvest. Olive leaf has been reported to affect the texture with harder muscle in Red sea bream (*Pagrus major*) (Arsyad et al., 2018). The target fish species is Japanese amberjack (Yellow tail)" and using this material find four effects the same as green tea power:

i. Reduce of fishy smell (No masking effect)
ii. Prevention of lipid surplus
iii. Prevention of red muscle browning (Keep fish freshness)
iv. Improvement of texture

Dried Olive leaves are used as healthy tea in Mediterranean area. Olive leaves have a bitter taste and it might provide low palatability for fish, however investigation on the adaptational period of dried olive leaves is still open in future studies.

Dry powder grape pomace
This material is the squeezed residue during grape juice or wine manufacturing, and it is got after drying and crashing process. Addition rate is about 1% in compound. The material feeding term is through all year. Grape pomace has been investigated on growth performance and apparent digestibility in rainbow trout and results were underlined to show benefits in terms of nutrient digestibility and feed conversion efficiency in trout (Peña et al., 2019). Further, the use of grape seed extract was evaluated in rainbow trout diets as a sustainable organic fish feed supplement. Based on the results obtained, grape seed extract incorporation of 1.05‰ were found to have beneficial effects in terms of growth performance and meat quality in rainbow trout (Kesbic & Yigit, 2019). This material has been confirmed the effect in Rainbow trout as following:

i. Keeping fish freshness
ii. Improvement of texture
iii. Prevention of lipid surplus
iv. Improvement of feed efficiency and growth rate

The Mediterranean, as a worldwide grape producing area, could benefit from the grape pomace in fish feed manufacturing, as a valuable and domestically available raw material.

Wood acetate acid

Wood acetate acid is by-product of the charcoal industry, and obtained by dry distillation of woods. In Japan usually, it is used in liquid or adsorbed powder in state. The material is added to the dry pellet compound before processing. Addition rate of material is about 1% in compound. The material feeding term is through all year excluding the juvenile -rearing period. Incidentally, the origin of the author selected material was made from evergreen broadleaves. Protein-rich microorganisms (*i.e.* single cell protein) can be produced as an important co-product in wood-based biorefineries, and has been reported to be an alternative for fishmeal substitution in fish diets. Fishes fed with diets, where fishmeal was partially substituted with Single cell protein, showed promising results in terms of growth performance (Alriksson et al., 2014). The target fish species are "Silver salmon and Rainbow trout" using this material find four effects:

i. Reducing fishy smell (No masking effect)
ii. Prevention of lipid surplus
iii. Keep fish freshness
iv. Improvement of texture
v. Keeping of good water quality by promotion of decomposition of organic matter like feces and remaining food in rearing ponds.

Conclusions and future issues to be considered

A number of researchers have focused their investigations on the search the new concerned raw materials. A remarkable number of aromatic plants and herbs such as cumin, paprika, puncturevine, allspice, wormwood, caper, dill, cress, linden, goosefoot, propolis, pomegranate, olive, garlic, grape, lavender, tetra, juniper berry, cinnamon, lemon balm, mallow, orange, oregano and bergamot are originating from the Mediterranean area. Therefore, the Turkish aquaculture sector has huge advantages in terms of raw material availability, and all these herbal plants provide great potentials for the formulation of high quality and differentiated diets (Yilmaz et al., 2022). Despite the fact that numerous studies have been published so far, regarding herbal plants incorporation in aqua-feeds, there is still much research area open in physiological effects of differentiated substances for fish's health promotion and encouraged in further studies for the benefits of Japanese, Turkish and worldwide aquaculture developments.

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No ethical approval needed for this study.

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References

Alriksson, B., Hörnberg, A., Gudnason, A.I., Knobloch, S., Arnason, J., & Johannsson, R. (2014). Fish feed from Wood. *Cellulose Chemistry Technology*, *48*(9-10), 843-848.

Arsyad, M. A., Akazawa, T., Nozaki, C., Yoshida, M., Oyama, K., Mukai, T. & Ogawa, M. (2018). Effects of olive leaf powder supplemented to fish feed on muscle protein of red sea bream. *Fish Physiology and Biochemistry, 44,* 1299-1308. https://doi.org/10.1007/s10695-018-0521-1

Baba, E., Acar, Ü., Öntaş, C., Kesbic, O. & Yilmaz, S. (2016). Evaluation of Citrus limon peels essential oil on growth performance, immune response of Mozambique tilapia *Oreochromis mossambicus* challenged with *Edwardsiella tarda*. *Aquaculture, 465*, 13-18. https://doi.org/10.1016/j.aquaculture.2016.08.023

Dawood, M.A.O, El Basuini, M.F., Zaineldin, A. I., Yilmaz, S., Hasan, Md. T., Ahmadifar, E., El Asely, A.M., Abdel-Latif, H.M.R., Alagawaby, M., Abu-Elala, N.M., Van Doan, H. & Sewilam, H. (2021). Antiparasitic and antibacterial functionality of essential oils: An alternative approach for sustainable aquaculture. *Pathogens, 10*(2), 185. https://doi.org/10.3390/pathogens10020185

Dawood, M.A.O., El Basuini, M.F., Yilmaz, S., Abdel-Latif, H.M.R., Alagawany, M., Kari, Z.A., Abdul Razab, M.K.A., Hamid, N.K.A., Moonmanee, T. & Van Doan, H. (2022). Exploring the roles of dietary herbal essential oils in aquaculture: A review. *Animals, 12*, 823. https://doi.org/10.3390/ani12070823

FAO. (2022). United Nations Food and Agriculture Organization, Fisheries and Aquaculture, Statistical Online Query, Global Aquaculture Production. https://www.fao.org/fishery/statistics-query/en/aquaculture. Accessed 24 February 2022.

Kesbic, O. & Yigit, M. (2019). Structural and chemical changes of grape seed extract after thermal processing and its use in rainbow trout (*Oncorhynchus mykiss*) diets as an organic feed supplement. *Aquaculture, 503,* 275-281. https://doi.org/10.1016/j.aquaculture.2019.01.021

Peña, E., Badillo-Zapata, D., Correa-Reyes, G. (2019). Use of grape pomace in formulated feed for the rainbow trout fry, *Oncorhynchus mykiss* (Walbaum, 1792). *Journal of World Aquaculture Society,* 1-9. https://doi.org/10.1111/jwas.12669

Yılmaz, S., Ergün, S., Yiğit, M. & Yılmaz, E. (2022). An Extensive Review on the Use of Feed Additives Against Fish Diseases and Improvement of Health Status of Fish in Turkish Aquaculture Sector. *Aquaculture Studies, 22*(3), AQUAST710. http://doi.org/10.4194/AQUAST710

Zhou, J., Lin, Y., Ji, H. & Yu, H. (2016). The Effect of Green Tea Waste on Growth and Health of Grass Carp (*Ctenopharyngodon idellus*). *Turkish Journal of Fisheries and Aquatic Sciences, 16*, 679-689. http://doi.org/10.4194/1303-2712-v16_3_22