# THE EFFECTS OF VARYING INCLUSION LEVELS OF *Saccharomyces cerevisiae* AND INCUBATION PERIODS ON AQUA-FEED BUOYANCY

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## ABSTRACT
*The production of on-farm non sinking pellets remains a challenge to fish farmers which necessitated for over reliance on imported extruded feeds. Most sinking feeds pollute water and are unavailable to fish for growth. In this research, the effect of varying inclusion levels of Saccharomyces cerevisae (floating catalyst) and varying incubation periods on feed buoyancy. Four feeds were formulated to contain the floating catalyst at 5%, 7.5%, 10% and 12.5% inclusion levels and each was incubated for 30, 45 and 60 minutes at 38 ºC respectively. The buoyancy test was conducted on the feeds and the results indicated significant effects of the treatments on feed buoyancy. The feed with 7.5 % floating catalyst and 30 minutes incubation had 95% floating rate for 60 minutes on water while, that which had 5% floating catalyst performed best at 60 minutes incubation with 85% floating rate for 60 minutes. The result indicated that, appropriate inclusion of bakers' yeast and incubation period with right feed constituents on feed constituents will produce desirable floating feed for aquatic organism.*

**Keywords:** floating feed, floating catalyst, non-extrusion

## INTRODUCTION

The overall goal of fisheries is to enhance sustainable development of fisheries resources hence to make the world self-sufficient in fish production. Fish is regarded as an excellent source of dietary protein, fat, vitamins and minerals that are important to the human diet for the maintenance of good health. It is also responsible for about 55% of protein intake sources of Nigeria citizens with an estimated demand of at least 1.5 million metric tons annually (Adekola, 2001). Fish is an important source of both food and income to many people in developing countries. In Africa, about 38 million people depend wholly or partly on fisheries sector for their livelihood (FAO, 1998). However, fish feed production is an important factor to be considered in both subsistence and commercial fish farming as it has direct effect on the growth potential of the sector (Tsevis and Azzaydi, 2000). Aquaculture feed can either be pelleted or extruded. The Feed will meet the nutrient requirements of fish if it has particles of high durability that can withstand handling and transportation and will be of good water stability to minimize disintegration and loss of nutrients upon exposure to water. Fish feed have significant effect on the cost of production as its account for 60-80% of management costs (Olomola, 1990). On-farm pelleted fish feed are reported to be liable to quick disintegration which resulted in nutrients loss and water pollution (Holm and Walther, 1988; Lopez-Alverado *et al*., 1994; Falayi *et al*., 2005; Yisa, 2008). Extruding pelleting machine is quite expensive which is responsible for high cost of imported floating feed (Eyo, 1995).

Feed extrusion is a process in which food ingredients are moistened, precooked, expanded, forced to flow (extruded), and dried under one or several conditions of mixing, heating and shear through a die that forms and/or puff-dries the ingredients producing a low density feed particle which float in water. An extruder provides grinding, hydration, shearing, homogenization, mixing, compression, gassing, thermal, treatment, gelatinization, protein denaturing, destruction of microorganisms and some toxic compounds, shaping, expansion, texture alteration and partial dehydration (Cheftel 1986). Like the extrusion technology, Baker's yeast under fermentation causes dough to rise thereby the baked item becomes spongy due to generation of carbon dioxide when in contact with warm water (Exploratorium, 2016; Dakotayeast, 2016). The condition that favours the multiplication of bacteria is a slightly acidic pH of 4.5-5.5, temperature between 27ºC and 42ºC beyond which they could be killed, Abaoba and Obakpolor, (2010) reported optimum temperature of 37ºC and timing of between 70 minutes and 200 minutes (Noel, 2016). Extruded floating feeds are preferred by many farmers because they allow for observation of the feeding process thereby preventing wasteful feeding, facilitates the inactivation and destruction of heat labile anti-nutritional factors and other contaminants and they are extremely stable in water. Extruded floating feed cost is however, a significant disadvantage over locally produced dried and moist pellets (Lovell, 1988). In Nigeria, fish farming holds a promising future for teeming unemployed young adults. However, high cost of imported feed remains a constraint which necessitated the need for this research to investigate into the use of *Saccharomyces cerevisae* (Baker's yeast) as floating catalyst under varying incubation periods.

## MATERIALS AND METHODS

### Experimental site

The research was carried out in the Water Resources, Aquaculture and Fisheries Technology department's laboratory of the Federal University of Technology Minna, Niger State, Nigeria.

### Source of feedstuffs and feed preparation

Feed ingredients used included groundnut oil, wheat flour, *Saccharomyces cerevisae* (bakers' yeast). They were purchased from Kure market in Minna, Niger State. The fish meal and wheat flour were each passed through 300µm sieve to remove unwanted particles.

### Fish feed formulation

Feeds were formulated to contain varying inclusion levels of *Saccharomyces cerevisae* (floating agent) using Pearson square method to obtain the following diets; feed 1 (5% baker's yeast), feed 2 (7.5% baker's yeast), feed 3 (10% baker's yeast), and feed 4 (12.5% baker's yeast).

**Table 1: Feed formulated at varying inclusion levels of *Saccharomyces cerevisae* (baker's yeast)**

| Ingredients | Feed 1 | Feed 2 | Feed 3 | Feed 4 |
|---|---|---|---|---|
| Fish meal | 35.08 | 34.08 | 33.07 | 32.06 |
| Wheat meal | 51.92 | 50.42 | 48.90 | 47.44 |
| Baker's Yeast | 5 | 7.5 | 10 | 12.5 |
| Mineral premix | 5 | 5 | 5 | 5 |
| Oil | 3 | 3 | 3 | 3 |
| Total | 100.00 | 100.00 | 99.97 | 100.00 |

### Experimental procedure

Each feedstuff were measured in right proportion into clean dry plastic bowls, *Saccharomyces cerevisae* (baker's yeast) was added in dry form and mixed thoroughly. Sixty millimetres (60 ml) of warm water was added to the mixture and mixed thoroughly until homogenous dough was obtained.

**Dough incubation, pelleting and drying**

Each feed was divided into three (3) and incubated at three (3) different periods (30, 45 and 60 minutes) respectively. The incubation was done using exhaust hot air from Air-condition at 38 ºC (Orire and Sadiku, 2014). The incubation allowed the dough to pulp up under the influence of carbondioxide production as yeast undergone multiplication and fermentation. The leavened dough was pelleted with 2mm die meat grinding machine. The Pelleted feeds were sundried and further dried in the oven at a temperature of 100 °C for 45 minutes.

**Buoyancy test**

The manufactured pellets were then subjected to buoyancy test by dropping 20 pieces of pellets into a 500 ml beaker half filled with water using a digital stop watch to record the numbers of pellets that sank every five minutes for 60 minutes.

**RESULTS**

The feed that had 5% floating catalyst and was incubated for 30 minutes gave an average floatation rate of 75% in the first 15minutes of immersion in water. The percentage then fell to about 50% in 30 minutes and further dropped to about 17% by the 55 minutes of immersion in water. When the incubation period was extended to 45 minutes, there was 78% improvement in the floatability of the feed which had an average floating percentage of 90% for the first 5 minutes of immersion but further dropped to about 70% throughout the immersion period of 60 minutes. Furthermore, when the feed was incubated for 60 minutes, the feed had 90% improvement in its floatability where the feed had 100% floatation for the first 15 minutes and about 85% for 60 minutes immersion in water. The best impact of incubation period on the bakers' yeast which ensured highest feed floatability rate was at 60 minutes.

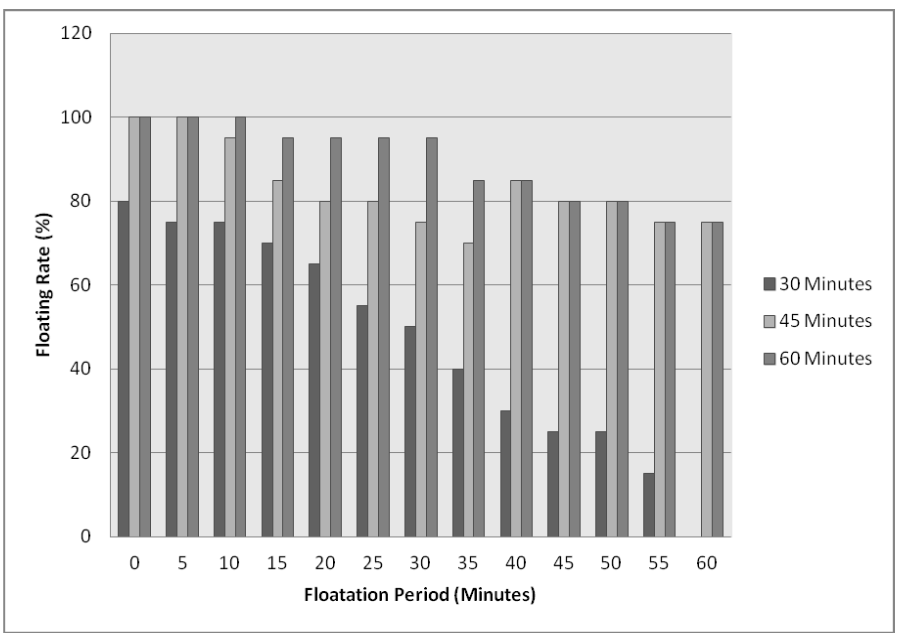


**Fig. 1: Effect of incubation periods on feed buoyancy at 5% baker's yeast inclusion level**

The floating potential pellets treated with 7.5% floating catalyst under varying incubation periods are shown in Fig. 2. The feed that was incubated for 30 minutes exhibited 95% floatation for 60 minutes. However, there was a significant reduction by 47% in the feeds floating percentage when the incubation period was increased to 45 and 60 minutes respectively. The feeds exhibited its best floating rate at an average of 42% and 40% for 60 minutes respectively. This result indicated that, the heat duration had a negative impact on the floating catalyst which resulted in reduction of its potency to generate sufficient air space that will ensure feed floatation.

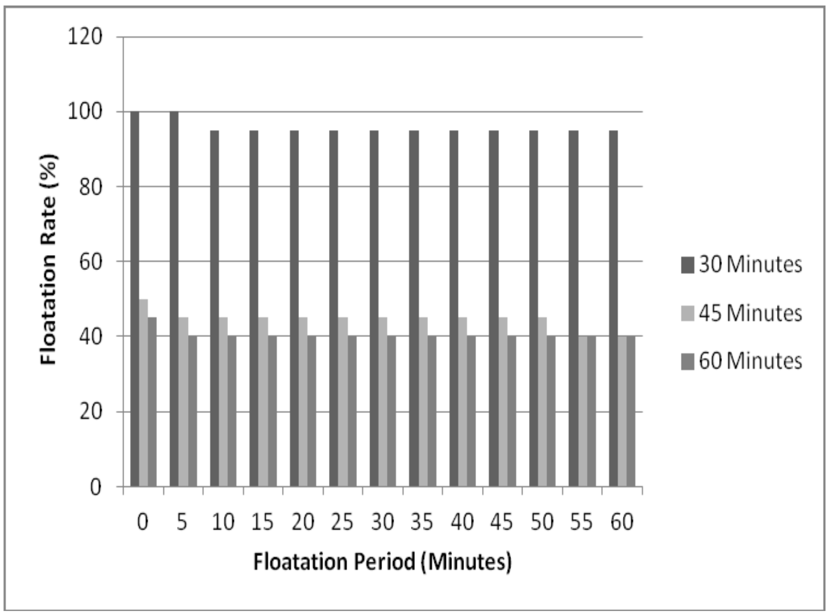


**Fig. 2: Effect of incubation periods on feed buoyancy at 7.5% baker's yeast inclusion level**

The floating percentage of pellets with 10% floating catalyst is presented in Fig. 3. The feed that had 30 minutes incubation gave an average floating percentage of 50% for 60 minutes. This percentage was reduced to 15% when the incubation time was extended to 45 minutes however; there was an improvement in the floating percentage to 20% as the incubation time went up to 60 minutes which floated for 60 minutes. The effect of incubation time on the feeds can be said to be at its best at 30 minutes which gave the highest percentage of floatation beyond which there was decline.

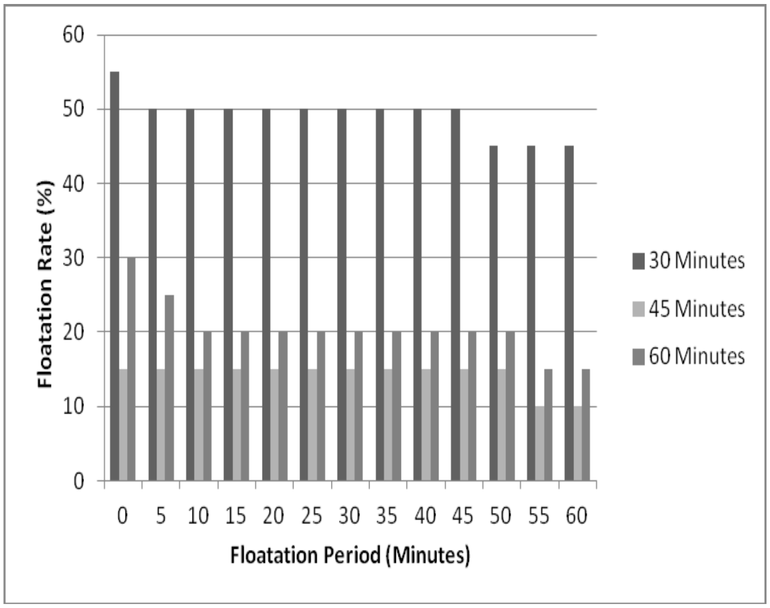


**Fig. 3: Effect of incubation period on feed buoyancy at 10% baker's yeast inclusion level**

Fig. 4 shows the performance of feeds floatability at an inclusion rate of 12.5% floating catalyst. It was observed that, the feed that was incubated for 30 minutes gave a regular floating percentage of 25% for 60 minutes. With increment of incubation time to 45 minutes there was an improvement in the floating percentage to 40% which floatation for 20 minutes which then dropped to 35% for the rest of the period. Moreover, the positive effect of elongation of the incubation period was observed on the feed buoyancy when it increased to 60 minutes. At this period, the floatation percentage was at an average of 50% for the first 15 minutes but then fell to 15% for 60 minutes of on water.

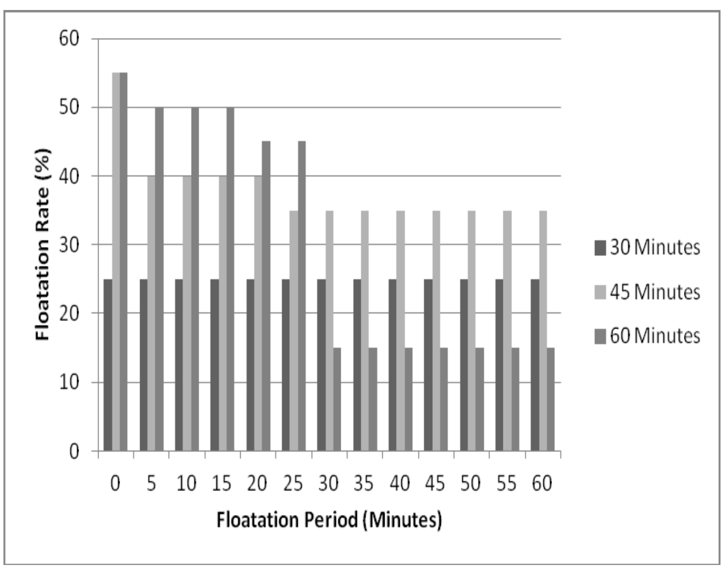


**Fig. 4: Effect of incubation periods on feed buoyancy at 12.5% baker's yeast inclusion level**

## DISCUSSION

The need for application of appropriate temperature and timing (incubation period) on the baker's yeast to produce sufficient carbon dioxide that would create the air bubbles in the dough was justified in the experiment. The feed that had 5% baker's yeast gave its best floating potential (85%) at 60 minutes incubation period at 37ºC. Furthermore, at a higher inclusion level of 7.5% floating catalyst, the feed gave a higher floating percentage of 95% but at a lower incubation period of 30 minutes, both of which floated for 60 minutes. The floatability of the feeds can attributed to appropriate inclusion of baker's yeast and optimum temperature for the production of airspace in the feed (Noel, 2016; Abaoba and Obakpolor, 2010) and incubation period that was responsible for production of carbon dioxide that causes the dough to expand (Plyer, 1973) thereby causing sinking pellet to float. The level of buoyancy attained (85-95%) could also be attributed to the inclusion levels of baker's yeast in the feed (Noel, 2016) which was sufficient to produce airy physical structure in the dough that resulted in light weight feed (Orire and Sadiku, 2014; Mbagwu and Adeniji, 1988 and Cheftel, 1986). The poor floatability performance of feeds with high inclusion levels (10-12.5%) of baker's yeast could be attributed to insufficient timing for bacteria multiplication or too much inclusion of baker's yeast (Noel, 2016). The feed's floatability rate of 60 minutes is a longer period than the minimum of 30 minutes reported by Holm and Walter (1988) which is considered enough time for fish to consume feed which would reduce the rate of nutrient loss to leaching (Kearns, 1989). Floating feed is beneficial to pelagic or surface feeders since they have quick access to the feed with less expended energy than going to the bottom to source for food (Balarin and Halver 1982) and farmers can have quick assessment of fish stock in the pond (Mgbeka and Lovell, 1988; Falayi *et al*, 2004).

## CONCLUSION

On-farm floating feed can be produced under careful feed formulation of appropriate inclusion of floating catalyst and under the right timing of temperature exposure. The findings revealed that, feed formulated to contain either 5% or 7.5% baker's yeast and incubated for 60 minutes or 30 minutes respectively will produce feed buoyancy with 85% to 95% and that would float on water for 60 minutes. The on-farm made floating feed is hence achievable and thereby recommended for fish farmers as it will reduce rate of water pollution in the culture systems and nutrient loss.

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