UNCONVENTIONAL FEED FOR THE GROWTH OF CATFISH: *Clarias gariepinus*

ABAH AYODELE Y
Matric no: [illegible]

AUGUST, 2009

UNCONVENTIONAL FEED FOR THE GROWTH OF CATFISH: *Clarias gariepinus*

BY

ABAH AYODELE, Y.
06/108

A PROJECT SUBMITTED TO THE DEPARTMENT OF FISHERIES, ABRAHAM ADESANYA POLYTECHNIQUES, IJEBU IGBO, OGUN STATE

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DIPLOMA IN FISHERIES.

CERTIFICATION

I certify that this research work was carried out by *Abah Ayodele,* in the Department Of Fisheries, Abraham Adesanya Polytechnic, Ijebu Igbo, Ogun State

Mrs. Olugbesan
Project Supervisor

07-09-09.
Date

Mr. Odubela
HOD SLT

Date

DEDICATION

This Research work is dedicated to the Almighty god;

and to Abah family

ACKNOWLEDGEMENT

I am grateful to a quite number of people whom the lord used in assisting me carrying out this research work. My deepest appreciation goes to my family for their prompt support toward the success of my program at school and this work.

I immensely appreciate my teacher and supervisor Mrs. Olugbesan for her patient, understanding and willingness to go through this work and offer useful suggestion for improvement. May the Lord richly bless your family.

CONTENT

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

REFERENCES

LIST OF TABLES

ABSTRACT

Experimental fish and other materials were sourced from school. Two meal were formulated using fishmeal and maggot. Maggot was produced from poultry droppings and animal carcass and harvested in 5 – 8days of culturing. The fingerlings used were weighted every 10days with weight sensitive balance to determine their growth rate.

The use of magmeal to feed fingerlings indicated high level of significant in terms of weight and length over fishmeal. Meanwhile, the different in weight between the fish fed with magmeal and those fed with fishmeal is an indication that supplementary feed is important in fish culturing.

After the experiment, fish were found to perform better on magmeal and it could therefore be used whole or partial replacement for fishmeal. Though farmer may find it difficult to process magmeal because of its labour intensive nature therefore the research recommed preparation of magmeal and sold to the farmer; constant replacement of

water; avoidance of over feeding when used either life or prepared maggot to feed.

CHAPTER ONE

INTRODUCTION

Overview

In fish rearing management of *Clarias geriepinus* conventional feeds are popularly used as diet. For example coppens, most of these feeds are costly and even scarce some times. In fact, this has necessitated the need for an alternative diet via the use of unconventional feeds, (Adenuga 2007).

Fish feeds utilized for fish culture is called 'Aqua feed'. Fish feed or food account for 70 - 75% of management cost, in fish culture (Adekoya 2001). For the expert to supplement conventional feed with unconventional feed, they have embarked upon series of research work. Zooplankton like Artemia, insects like termite, maggot, and worms earthworm etc had been use as alternative to conventional feed.

The growth of fish depends, among other factors on the quality and quantities of natural feed available in pond. This

criterion also applies to the inputs of artificial supplementary feeds, (Tilapia International Association. TIA, 1988). Much work has been done on fish nutrition using different kind of live feed and artificial compounded diet. Madu et al (2001), made use of Artemia Salinia, Indegeneous Zooplankton (mixed population) and power fish meal as starter diets in the early nursery of *Clarias gariepinus*

In Nigeria fish culture is claiming space in the economy, fish is reared in both rural and urban area, to in crease the supply of source of protein, basic self employment for the determined enthusiast, to provide spring board for the development of local technology to accelerate food production option for the ever growing population of the country, (Adenuga, 2001).

Approximately 30% of the total fish catch are converted to fish meal and fish oil for the use in animal feed annually. The percentage of meal used for aqua-culture feeds has increase from 10% in1988 to around 45% in 2002 and the actual amount of fish

harvested to produce fish meal as remained constant as 30 million/year (FAO 1999). Aqua –culture is likely to grow higher over the next 20 years and some expert are concerned that rising pressure on already threatened stocks of fish (Belgodo et al, 2003). It will also increase the already high cost of fishmeal in the world market, several attempts have therefore been made to find adequate substitute for fishmeal in the diets.

The Interest of this study is the use of maggot meal as a substitute for fishmeal. Maggot that is of animal origin has been known to possess a great value (Adesulu and Mustapha 2000 Fasakin et al 2003). Based on cost effectiveness, availability and crude protein, the maggot grown on animal waste seen to have an immense potential as a good protein source for fish. Maggot meal is of high biological value.

The percentage of crude protein ranges between 39 - 55%, lipid 12.5 - 21% and crude fibre 5.8 - 8.2% maggot meal is also

high in: Phosphorus; Trace element; and B complex vitamins, (Testia and Miller, 1973).

According to Ogunji et al (2007) the incorporation of maggot meal into catfish diet seems to have no oxidative stress generating effect on fish metabolism. It contains no compound to stimulate the generation of relative oxygen, species (maggot) can effectively be used as alternative protein source in catfish (*Clarias gariepinus*) fingerlings production. This study attempts to evaluate the growth performance of catfish (*Clarias gariepinus*) feed maggot meal.

Research Question

- What is unconventional feeds?
- What other materials can be used as unconventional feed?
- Will unconventional feed support the growth of (*Clarias gariepinus*)

- How to breed maggot for feeding fish.

Objective of the study

This research work was carry out in order to obtain a supplementary feed that is of required nutritional value for the better growth of (*Clarais gariepinus)*

Significance of the study

The significance of the study is to help the farmers' i.e. fish farmers in the following ways:

- To understand how to breed maggot.
- To understand that unconventional feed will reduce the cost of production of fish.
- To understand the precepts in feeding fish with maggot

Delimination

This research work is delimited to the following ways:

- The use of maggot as unconventional feed
- The use of yeast to breed maggot
- The use of tank, pond, vessels, etc.
- The subsistence fish farmers.
- Homestead fish farming practitioners

Definition of Terms

Aqua feed: feed given to fish.

Homestead: home based fish rearing.

Unconventional feed: alternative feed, which can be made with locally available materials.

Zooplankton: micro animals in water.

Fish meal: meal/food made with fish to feed live stock.

Starter meal: feed given to the young livestock.

TIAS: Tilapia International Association Belgium.

Supplementary feed: feed given to fish in addition to natural food.

Tank: pond/vats e.t.c.

CHAPTER TWO

LITERATURE REVIEW

Fish in the natural or wild water body takes longer period of time to grow to table size because they feed on natural sources of food available in the body of water. In tanks, a shorter length of time is required for profitable enterprise. To make fish grow faster in the tank/pond supplementary diet is necessary, (ADP, 2001).

Fish feed must go into water before being utilized and therefore need to be substantially stable in water for a few minutes to allow its intakes by fish, (ADP, 2001; Adekoya, 2001; Adenuga, 2007).

Soya feed ingredient has been investigated in an attempt to find meal in the diets of catfish. This includes animal protein sources such as the fishery by products such as hydrolyzed factor, bone meal and blood meal. Plant portion sources including Soya beans meal, cotton seed meal, groundnut meal, sunflower, rape

seed, sesame seed, macadamia and palm kernel were also evaluated along with aquatic plant such as *Asolla pinmats*, duck weed *(lomnacaece)* and single cell protein (Ogunji, 2004); B1-Sayed, 1999; and Sayed and Tacon 1997).

Based on locally available materials, opportunities, the farmer's resources, aqua-supplementary feed can be grouped into:

- Compounded feed (diet)
- Natural fish foods
- Lime-food
- Offal / linnard
- Poultry egg food
- Junk feed, (Adekoya, 2007)

The choice is that of the farmer in most cases but care must be taken in applying any of these feed option to avoid increase in pollution of microbes and unwanted fish kills, (Adekoya, 2001; and Olurin, 2001). Compounded feed based on professional formula is ideal for fish culture (Adekoya 2001). The

approximation analysis of such compounded fish feeds/diets vary depending on the fish farm needs (i.e. hatching or table size fish production/ such variation make it advisable for fish farmers to provide fish feed for their specific form need; (ADP 2001) Adekoya 2001; Olurin 2001). Aside, natural fish foods are derivable from the natural fish tank (pond) medium resources through inoculation, and fertilization, (Adekoya, 2001). They are essential for fish growth under culture but not sufficient to assure prompt time bound growth weight under intensive fish culture, (Adekoya, 2001; Olurin, 2001; and Adenuga, 2007), such natural food includes: Alga (including phytoplankton, zeroplantton etc). crustanceans, protozoans, and other minutes organisms.

Lives foods for fish, used for fish culture depending on their availability, they are poor alternatives to compounded fish feeds in terms of cost but locally available maggot, earthworm, termites and other in needs, (Adenuga, 2001; ADP, 2001).

Offal as fish foods depending on the resources of farmer. These are also powder alternative to compounded fish diet. Examples are poultry offal. Poultry eggs food (i.e. carcass from poultry) and hatchery are boiled and chopped before serving to fish. These are very rich in protein, and essential nutrients. They are therefore assuming good growth performance. The fish produced may however be fairly fatty apart from the lost of the exercise. These alternatives are not too poor to compounded diets. It is useful for integrated farms at the time of substantial poultry egg-gluts, (Adekoya, 2001; and Adenuga, 2007). Feeds are basically agricultural bye-product, which are used for feeding fish. They are the poorest alternative to the compounded diets, Adekoya (2001).

These feeds are only considerably cheaper than fishmeal but also enjoying high availability and accessibility in certain regions of the world. Unfortunately attempts to use this ingredient to replace the fish meal component in forming catfish diets have

variable success with some of the factors which may have contributed to the variation in result obtained as summarized by Ogunji, (2004). To include protein composition and amino acids profile of alternative feeds; apparent digestibility of feed feeds, phosphorus, content of alternative feeds (especially in plant protein sources) and palatability/acceptability of alternative feeds.

Interest to study the use of housefly maggot meal (magmeal) as substitute for fishmeal in fish diets has increase in recent times. Magmeal which is of animal origin has reported to possess a great potential, (Adesulu and Mustapha, 2000, Fasakin et al, 2003, Ajani et al 2004, and Ogunji et al 2006).

Based on most effectiveness, availability and crude protein content, and the housefly larvae grown on animal waste seem to have an immense potential as a good protein sources for fish. Magmeal is high in biological value.

According to Ogunji et al (2007), the incorporation of mag meal into catfish diets seems to have no oxidative stress

penetrating effect on fish metabolism. It contains no compound to stimulates the generation of active oxygen and can effectively be used as an alternative protein source in fingerlings production. Unfortunately attempts to use protein source of plant or animal origin as complete replacements for the fish meal component in fish diets showed varying success. Ogunji (2004), summarized some of the factors which may have contributed to the variation in the results obtain like protein composition amino acid profile of alternative, feeds, apparent digestibility of feeds, phosphorus alternative feeds, anti-nutritional factors in alternative feeds (especially in protein source of plant origin and palatability/acceptability of alternative feeds). A relatively new approach is the use of insects as source of animal protein in fish nutrition. Bondary and Sheppard (1981) stressed that in various developmental stage insects have been used to feed fish and animal.

Hicling, (2004); and Wonlbier, (2005); noted that silla worm pupae have been an important component of carp diet in Japan and China. Interestingly study the uses of house fly maggot meal (mag. meal) as substitute for fishmeal in fish diets have increased in recent time (Adesulu and Mustapha 2000).

Maggots are produced from the semi transparent larval stage of the housefly (*Musca domestica*) and are used to process magmeal. Studies have shown that mag. meal is of high biological value. The percentage of crude protein ranges from:-

- Crude protein :- 39 - 61.4%
- Lipid 12.5 - 21%
- Crude Fibre 5.8 - 8.2%

Magmeal is also reach in: -

- Phosphorus
- Trace elements
- B complex, (Testia and Miller, 1973).

Examination of the comparative amino acids profile of fish and fly larvae protein showed that no essential amino acid was limiting. Spineu et al, (1979); Ajani et al, (2004); Fashina, Bombata and Balogun, (1997) reported that magmeal can replace up to 100 percent of fish meal in the diets of catfish (*Clarias gariepinus*). Researches concluded that the biological value of magmeal was equivalent to that of whole fishmeal and that the larvae contain no anti-nutritional or toxic factors, sometimes found in alternative protein source of vegetable origin.

Until now the use of magmeal in fish nutrition is not connected with any economic advantage. According to Fashina, Bombata and Balogun (1997) the cost of harvesting and processing one kg of magmeal is less than 20% of 1kg of fishmeal. Base on cost, availability, biological value and feed conversion ratio, magmeal is said to be a viable alternative to all fishmeal in the diet of fish.

CHAPTER THREE

MATERIAL AND METHODS

Experimental site

The study was carried out in the Abraham Adesanya Polytechnic, hatchery pond, ijebu – igbo, Ogun State.

Source of Experimental Fish and Other Materials

100 fingerlings of (*Clarias gariepinus*) were selected from the school hatchery pond. Two meals were formulated from fishmeal and maggot.

The fish were bought from the local market while the maggots were produced by culturing.

Maggots were produced from poultry dropping and animal carcass. Three pits were filled with these wastes (poultry droppings) the pit were covered with plastic sheets to prevent the substrate from being saturated by raining, as well as keeping the substrates moist and to achieve best result the best results. In

other to haste the production of maggot, yeast was added to the substrates.

Preparation of Maggot Meal

Maggots were ready for harvesting in 5 - 8 days. Sieves and trays were used to get them from the substrates, thus the substrates containing the animals were put on the sieve (mesh size of 2.0 – 3.0mm) and place over the tray and place in the sun. Being phototoxic, it moves away through the sieve into the tray. They were washed with water and dried separately for five days in the sun and in the oven at 50°F for 24 hrs.

Composition of Formulated Meal

	Fish meal (g)	Magmeal (g)	%
Fish meal	400		28.6
Maggot		400	28.6
Corn	280	280	20.0
Rice bran	200	200	14.3
Spent brew	200	200	14.3
Brewer`s yeast	200	200	14.3
Ground nut cake	120	120	8.6

Experimental Layout / Stocking

Two hapas were built in a pond and catfish were then obtain from the experimental feeds (fishmeal-a, maggot-b) each hapa was stocked with fifty fingerlings. The fingerlings were weigh before putting them in the hapas to know the initial weight.

Feeding of fish

Fish in the two hapas were feed threes times (4 hrs interval starting from 6:30 am) a day. Fish fingerlings were then weighed every ten days with weight sensitive balance to determine growth rate.

Fingerlings were weighed in mg due to their small size and the fact that they were very delicate: also weighing them individual did not give any appreciable difference in the weight.

Monitoring of Physio-Chemical Parameters

Others environmental factors like temperature and oxygen that could affect the growth were also taking care of surface and bottom temperature of the water were measure with thermometer, oxygen with oxygen meter, pH with pH meter, water conductivity with conductivity meter.

The environmental factors were measure in ten days intervals and presented in table 4. The results obtained from the experiment were then subjected to analysis of variance, ANOVA.

Relationship

Growth Indices

Growth Rate (GR)

Growth Rate = Wii -Wi/0.5(Wii - Wi)t x 1000 ml/g/day

Where

Wii = final weight of the fish

Wi = initial weight of the fish

t = number of days

Weight Gained (WG)

WG = Wii – Wi (g)

Where

Wii = Final Weight Gained

Wi = Initial Weight Gained

Specific Growth Rate (GSR)

SGR = in Wii – Wi/t (g/day)

Where

Wii = Final Weight of fish

Wi = initial weight of fish

t = number of days

CHAPTER FOUR

RESULT, AND DISCUSSION OF FINDINGS

Table1: Average Weight Increment and Food Conversion Ratio

Meal(s)	Replicates	Initial weight	Final weight	Mean weight	Food fed	FCR	Weight gain	GR	SGR
Fishmeal	i	8.157	24.858				23.70		
"A"	ii	10.715	18.750	16.868	10.121	0.600	10.04	40.82	0.484
Maggot	i	0.970	33.867				32.89		
"B"	ii	11.639	18.750	22.000	17.600	0.800	7.11	40.82	0.145

Table 2: ANOVA Analysis Of Weight Gained

Source of variance	SS	df	MS	F_{cal}	F_{tab}	Remark
Between group	27.02	1	27.02	3.026	1.26	Sig.
Within group	1767.83	198	8.93			
Total	1796.85	199				

Table 3: Average Length Increment

Meal(s)	Replicate	Initial length	Final length	Length increment	LGR	LSGR
Fish meal "A"	I	0.75	0.83	0.08	0.1013	0.0114
	Ii	0.75	0.93	0.18	0.2143	0.0215
Maggot "B"	I	0.75	0.90	0.15	0.181	0.01823
	ii	0.75	0.79	0.22	0.2558	0.02572

N = 100

Table 4: ANOVA Analysis of Length

Source of variance	SS	df	MS	F_{cal}	F_{tab}	Remark
Between group	0.00111	1	0.00111	198.09	1.26	Sig.
Within group	0.10766	198	0.000056			
Total	0.1077	199				

Discussion of the finding

Table 1revealed 22.00mg mean weight of fish fed with maggot which is higher than the mean weight of the fish fed with fishmeal though, the weight gained of fish fed with fed with maggot is low compare with those fed with fishmeal but the growth rate is re cognizable .at initial stage; all the fish were found to increase the weight constantly. The average increment and feed conversion ratio [FCR] as show in table 1 above

Maggots were also found to contain high protein than fish meal this could have also contributed to the high growth of fish fed on the maggot and also the high crude lipid crude act as protein sparer to maximize growth. The fry were of the same size weight after the experiment. Those fed with the maggot have the lowest and still gave the best growth performance for this meal ; which mean that feed is easily digestible and palatable. Oti (1998), Sackey (1978) , Spinneli (1978) also made this observation .Also small fish have been found to eat more feed to increase weight when

fed on different feeds ,and could have contributed to the highest growth performance by maggot meal. Sackey (1989)and Yaqub (1991) ,also noted that bigger fish eat more and gain more weight when fed mean while ANOVA shows that there was significant difference in weight gained at 0.05 level of significant.

Table 3 shows that the fry fed with maggot have highest increase based on length. This implies that the fry. ANOVA shows that there was significant different in the Final length of fry fed with maggot compare to that of fishmeal

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

Summary

This study is to examine the unconventional feed in support of catfish: *clarais gariepinus* growth. The study was carried out in Abraham Adesanya Polytechniques, Ijebu - Igbo. The use of maggot meal to feed fingerlings indicated high level of significant in terms of weight and length over fish meal. Meanwhile the different in weight between the fish that were fed with maggot meal and those that were not fed is an indication that supplementary feed is important in fish culturing.

Though the production maggot, which involve culturing, and harvesting were very labourious; it was time and energy consuming. But proves to be a good supplementary meal which is less expensive; therefore the use of maggot reduces the cost of production.

Conclusion

After the experiment, fish were found to perform better on maggot meal. Maggot meal could therefore be used whole or partial; replacement of fishmeal. However, laborious nature of harvesting could be a major constraint tom the potential of maggot as a source of protein for fish and fish meal replacement.

Recommendation

Farmer may find it difficult to use maggot meal to formulate feed due to the work involve, therefore, the research hereby recommends the following based ion the outcome of the experiment:

1. More research should be carried on, in this area of unconventional feed.
2. Maggot meal needs to be prepared and sold to the farmers on like other meal: this will make it readily available for use; either by using with other meal or solely used to feed fish.

3. When using maggot in any form, either processed or live, the farmer must avoid over feeding.
4. Constant replacement of the pond water is necessary to prevent microbes' increment in the pond, which may reduce dissolve oxygen in the water.

References

Adenuga, (2001). Construction of Concrete Fishpond. Tai Solarin College of Education. Ijagun

Adesanya Z. A., (1988). Homestead fish pond(s) department of Fisheries Forestry and water Resources, Abeokuta Ogun state.

Aqua-leafleat, (2006). Basic biology of catfish, technology and information Services. Bureau of Fishries and Aquatic Resources, National Freshwater Fishries Technoogy Center CLSU Compound, Munoz Nueva Ecija.

Axelrod, H.,W.E., Burgess, and C.W. Emmens. (1987). *Dr . Axelrod's mini- atlas of fresh water aquarium fishes.* TFH publications 992 pp.

Helen Anderson and David Cummings november (1999).

Measuring the salinity of water. Mel bomrne Lcoo64, pp1-4.

http://www.sa Water Watch .org. and monitor. htm. Retrieved 12/6/2008

Francis-floyd, R.(1992). Dissolved oxygen for fish production.

Fact sheet fa27. Institute of food and agricultural sciences, University of Florida. html : file: //C:/ users/ abim/ documents/ turbidity mht. Retriveved 6/5/2009

Mills, D. (1984) A fish keeper's guide to community fishes.

Tetra press , 117pp

APPENDIX

DATA ANALYSIS

Meal(s)	Replicate	Initial weight	Final weight	Mean weight	Food fed	FCR	Weight gain	GR	SGR
Fishmeal	i	1.157	24.858				23.70		
"A"	ii	8.715	18.750	16.868	10.121	0.600	10.04	40.82	0.484
Maggot	i	0.970	33.867				32.89		
"B"	ii	11.639	18.750	22.000	17.600	0.800	7.11	40.82	0.145

N = 100

Where $X_{fm} = 1$, $X_m = 2$

$N = n_1 + n_2 = 100+100 = 200$

$T = t_1 + t_2 = 33.736 + 40.008 = 73.744$

$\Sigma\Sigma X^2 = \Sigma X_i^2 + \Sigma X_{ii}^2 = 662.44 + 1132.78 = 1795.22$

$SS_t = \Sigma\Sigma x2 - T^2/N$

$= 1795.22 - 73.744/200$

$= 1795.22 - 0.36872$

$= 1794.85$

$SSw = \Sigma i\Sigma x2 - \Sigma (T_i^2/n_i)$

$= 1795.22 - 27.39$

$= 1767.83$

$SSb = \Sigma(T_i^2/N_i) - T_i^2/N_i$

$= 27.39 - 73.744/200$

$= 27.39 - 0.36872$

$= 27.02$

$df_t = N - 1$; $df_b = K - 1$; $df_w = N - K$

$df_t = 200 - 1 = 199$;

$df_b = 2\text{-}1 = 1$;

$df_w = 200 - 2 = 198$

$MS_b = SS_b/df_b = 27.02/1 = 27.02$

$MS_w = SS_w/df_w = 1767.83/198 = 8.93$

$F = MS_b/MS_w$

$= 27.02/8.93$

$= 3.0257$

ANOVA Analysis Of Weight Gained

$X_{fm} = 16.868$; $X_m = 22.000$

X_{fm}	X^2_{fm}	X_m	X^2_m
23.701	561.74	32.897	1082.21
10.035	100.70	7.111	50.57
33.736	662.44	40.008	1132.78

Where $X_{fm} = 1$, $X_m = 2$

$N = n_1 + n_2 = 100+100 = 200$

$T = t_1 + t_2 = 33.736 + 40.008 = 73.744$

$\Sigma\Sigma X^2 = \Sigma X_i^2 + \Sigma X_{ii}^2 = 662.44 + 1132.78 = 1795.22$

$SS_t = \Sigma\Sigma x2 - T^2/N$

$= 1795.22 - 73.744/200$

$= 1795.22 - 0.36872$

$= 1794.85$

$SSw = \Sigma i \Sigma x2 - \Sigma (T_i^2/n_i)$

$= 1795.22 - 27.39$

$= 1767.83$

$SSb = \Sigma(T_i^2/Ni) - T_i^2/N_i$

$= 27.39 - 73.744/200$

$= 27.39 - 0.36872$

$= 27.02$

$df_t = N - 1$; $df_b = K - 1$; $df_w = N - K$

$df_t = 200 - 1 = 199$; $df_b = 2-1 = 1$; $df_w = 200 - 2 = 198$

$MS_b = SS_b/df_b = 27.02/1 = 27.02$

$MS_w = SS_w/df_w = 1767.83/198 = 8.93$

$F = MS_b/MS_w = 27.02/8.93 = 3.0257$

Summary Of Statistical Outcome

Source of variance	SS	df	Ms	f-cal	f-tab	Decision
Between group	27.02	1	27.02	3.026	1.26	Sig.
Within group	1767.83	198	8.93			
Total	1796.85	199				

ANOVA Analysis of Length Increment

Meal(s)	Replicate	Initial length	Final length	Length increment	LGR	LSGR
Fish meal	I	0.75	0.83	0.08	0.1013	0.0114
"a"	Ii	0.75	0.93	0.18	0.2143	0.0215
Maggot	I	0.75	0.90	0.15	0.181	0.01823
"b"	ii	0.75	0.79	0.22	0.2558	0.02572

N = 100