Journal homepage: www.fia.usv.ro/fiajournal
Journal of Faculty of Food Engineering,
Ştefan cel Mare University of Suceava, Romania
Volume XXIII, Issue 1- 2024, pag. 43 - 50

FOOD AND ENVIRONMENT SAFETY

COMPARATIVE EFFECTS OF FORMULATED SOYBEAN DIETS ON THE GROWTH PARAMETERS OF CATFISH (*CLARIAS GARIEPINUS*) FINGERLINGS

***Godfrey C. ONUWA[1] and Adeola O. OLANIHUN[1]**

[1]*Department of Agricultural Extension and Management, Federal College of Forestry, Jos, Nigeria*
onuwag@gmail.com
*Corresponding author
Received 23th October 2023, accepted 25th March 2024

Abstract: *The study evaluated comparative effects of formulated soybean diets on the development of juvenile catfish (C. gariepinus) at the Fishery unit, Federal College of Forestry Jos (FCF, Jos), Plateau State Nigeria. The parameters assessed were length, width, weight gain and survival rate; the experimental period was 6 weeks (42days). A total of 150 C.gariepinus fingerlings were purchased at the Fishery unit, FCF, Jos for the experimental study. The experimental setup comprised five treatments and each replicated. The trial layout was a randomized complete block design (RCBD) utilizing five (5) treatments; with one (1) control. Collected data was analysed using ANOVA and average values were isolated utilizing the New Duncan multiple range test at 5% ($p \leq 0.05$) likelihood level. Diet formulation was done using a Pearson square method. The graded inclusion levels of the soybean diets [soybean residue (SBR) and soybean meal (SBM)] were: Treatment one (T1) (100% SBR); Treatment 2 (T2) (25% SBR/ 75% SBM); Treatment 3 (T3) (50% SBR / 50% SBM); Treatment 4 (T4) (75% SBR/25% SBM); and Treatment 5 (T5) (100% Control). The results revealed that C.gariepinus fingerlings in T5 indicated pre-eminent values for the growth parameters with regards to average length (7.00cm), width (2.48cm), weight gain (0.52kg) and survival rate (97%). Therefore, this study recommends increased utilization of soybean meal (100%) formulated at 44% crude proteins as the central diet for C.gariepinus fingerlings; intensification of soybean production and extensive research on formulated soybean diets in aquaculture systems.*

Keywords: *Fingerlings diet, growth criterion's, inclusion levels, juvenile catfish, relative effects*

1. Introduction

Fish is crucial for global food security, job creation, income generation, and earnings in foreign currencies [1]. The Food and Agriculture Organization [2] posited that many developing nations' food systems depend heavily on fish and fishery products. Fish is a wellspring of high worth protein and a fundamental wellspring of micronutrients such as vitamins, minerals and polyunsaturated omega-3 acid [3]. Aquaculture has been perceived as a fast growing sector; with the greatest potentials to meet the increasing demand for fish [4]. A record 42% of the world's fish production was produced through aquaculture and Sub Saharan Africa (SSA) contributed just 9% to these gross output worldwide [2][5]. Aquaculture aims to increase the levels of fish productivity. [6], [7] In their studies observed that the insignificant contribution to aquaculture production from the region can be credited to issues such as inadequate aquaculture improvement approaches; financial barriers; poor technological advancements and methodologies; absence of fish seed; inaccessibility to feed; inadequate extension administration and poor synergy between research and development. The significance of aquaculture can't be undervalued given that the vast majority of their products are for household consumption. Catfish (*Clarias*

DOI: https://doi.org/10.4316/fens.2024.004

gariepinus) are among the most valued fresh and marine water fish species in SSA [8]. Catfish is regarded to have high nutritive value. The nutrients derived from catfish include vitamins, calcium, phosphorus and unsaturated fat [9]. They are very hardy and have accessory air breathing organs, which enables them to tolerate low dissolved oxygen levels and other adverse aquatic conditions where most cultivable species cannot survive. Catfish is one of the most prevalent aquaculture specie. However, feed assumes a significant part for cultured catfish, particularly at beginning phases. Different studies posited that mortality rate and poor development where significant barriers in catfish farming [10]. In a hatchery, fingerling productivity depends on availability of adequate feed and the require high protein food for survival and growth [11]. Production of fingerlings is a very vital stage in catfish farming. The larval period is considered critical in their life history. The availability of appropriate diets that is easy to consume, digestible, containing nutritional requirements that support healthy growth, and adoption of modern management practices are crucial in the initial phases of larval production in fish cultures [12]. Thus, success at this larval stage is mainly determined by fry feeding and nutrition [13].

At the larval stage, species like catfish, carps, salmon, and trout have generally been raised in aquacultures successfully. Hatchlings frequently rely upon live food. Live food varieties are exceptionally edible, given their lower supplement fixation [14]. Be that as it may, *C.gariepinus* hatchlings production is generally difficult because of their little size and absence of a functioning system for digestion [15]. Incidence of loss in hatcheries increase as the fingerlings wean over from yolk retention to feeding exogenously [12]. Providing nutritional fingerling feeds can be challenging since the systems for processing and ingestion, as well as healthful prerequisites change during their advancement [16].Therefore, feeding has been recognized as the major problem in the management of hatchlings to fingerlings [2]. Feed is an expensive component in aquaculture production and a substantial cost in catfish farming. Fish feed is extremely expensive due to the higher protein content than that of other cultured livestock. [17]. Studies revealed that African catfish expects around 35% crude proteins in their eating regimen and ideal outcomes have been accomplished with crude protein estimates between 40-50 percent for these species. In recent years, Nigeria has experienced an increase in major feed stuff shortages [18]. It has become more challenging to source for basic raw materials for feed formulation [19], [20]. In developing nations, starter feeds which incorporate live feeds, for example, capsulated *artemia* and commercial starter feeds are imported and costly much of the time. The majority of farmers cannot afford the prices. Numerous hatcheries now formulate their own fingerling feeds to reduce reliance on costly live feed [21]. Also, an alternative protein source such as maggot meals, derived from waste is reported to have very high nutritive content [22], [23].The cost component is an important factor to be considered in formulating feed. It is likewise critical that alternative diets contain every fundamental amino acids, unsaturated fats, vitamins and mineral requirements of the fish for fast development, healthy wellbeing and financial productivity [24]. As a result, substituting alternative protein sources for fishmeal—either in part or entirely—may provide significant financial advantages. Therefore, the effect of feeding *C. gariepinus* fingerlings varying inclusion levels of fermented soybean residue on growth performance is evaluated in this study. Also, the study focuses on the indices of growth of *C. gariepinus* larvae in aquaculture systems, fed specially formulated feed. Thus, findings of this study will help educate farmers on effective and highly efficient means of larvae feeding that enhances fish production and ensures food security. Specifically, this study sought to address the following research objectives:

i. Determine the graded inclusion levels of the formulated soybean diets.
ii. Evaluate the comparative effects of the formulated diets on growth parameters of *C. gariepinus* larvae.

2. Materials and methods

2.1. Study area

This study was conducted in Plateau State, Nigeria, at the Fishery unit of the Federal College of Forestry Jos (FCF, Jos). It is situated in the Northern Guinea savanna; with coordinates at 9°55' latitude and 8°54' longitude. Its topography is around 1,250m above sea level and stands at a level of around 600m over the encompassing lowlands; a relatively high elevation. Mean temperature is between 21 and 25 degrees Celsius. Rainy season occurs from April to September, while the dry season is between October to March [25]. Also, annual average precipitation in the area is 1,260 millimeters [2].

2.2. Experimental fish

FCF, Jos, Fish Farm supplied the 150 *C. gariepinus* fingerlings, each weighing 0.11 kilograms and 2 weeks old on average. In the Fishery unit, the fish were acclimatized in the biological garden, for a week and fed with feed formulation compounded at 44 percent crude protein.

2.3. Preparation of experimental units (*C. gariepinus* larvae)

Ten (10) plastic bowls of 50lt capacity were erected at the biological garden in FCF, Jos. Promptly after acclimatization; the fingerlings were arranged and arbitrarily loaded into the ten (10) plastic dishes at the pace of 15 fish for each bowl. The fish was famished overnight to purge their stomach and increment their feed craving and ingestion of introduced diets. The fingerlings were taken care of with the exploratory eating regimens at 5% body weight. The fingerlings were nourished with the experimental diets at 5% body weight two times daily for 42 days.

2.4. Experimental design

The experimental setup comprised five treatments and each replicated. The layout for the trial was a randomized complete block design (RCBD), utilizing five (5) treatments and one (1) control. The treatments were labeled as: T_1 D_1 D_2; T_2 D_1 D_2; T_3 D_1 D_2; T_4 D_1 D_2; and T_5 D_1 D_2 for easy identification and monitoring as adapted from [25]. The catfish fingerlings were raised for a period of 6 weeks. The fingerlings were exclusively fed the formulated diets. They were fed twice daily; morning (8.00am-09.00am) and evening (6.00pm-7.00pm) for 42 days.

2.5. Experimental materials

Bowl; Scope net; Fish meal; Soybean meal; Soybean residue; Maize meal; *C. gariepinus* fingerlings; Fish premix; Rice bran; Water; Pellet Machine; plastic bowls.

2.6. Statistical analysis

Collected data was analyzed using ANOVA, and mean values were isolated utilizing the New Duncan multiple range test at $p \leq 0.05$. All data was analyzed using the SPSS-23 and Excel 2010.

3. Results and discussion

3.1. Graded inclusion levels of formulated soybean diets

Diet formulation was done using a Pearson square method to determine the graded inclusion levels of all ingredients at 44% crude protein level. The following values were obtained as inclusion levels of all ingredients in the soybean diets [soybean residue (SBR) and soybean meal (SBM)] and presented in Tables 1,2,3,4 and 5:

Table 1

Treatment one (T1) (100% SBR)

Ingredient (s)	Inclusion Levels
Fishmeal	410g
Soybean	410g
Maize meal	90g
Rice bran	90g
Fish premix	40g

Source: Authors computed results (2020)

Table 2

Treatment 2 (T2) (25% SBR; 75% SBM)

Ingredient (s)	Inclusion Levels
Fishmeal	410g
Soybean meal	307.5g
Soybean residue	102.5g
Rice bran	90g
Fish premix	40g
Maize meal	90g

Source: Authors computed results (2020)

Table 3

Treatment 3 (T3) (50% SBR; 50% SBM)

Ingredient (s)	Inclusion levels
Fish meal	410g
Soybean meal	205g
Rice bran	90
Maize bran	90g
Maize mea	90g
Fish Premix	40g

Source: Authors computed results (2020)

Table 4

Treatment 4 (T4) (75% SBR; 25% SBM)

Ingredient (s)	Inclusion levels
Fish meal	410g
Soybean residue	307.5g
Soybean	102. 5g
Rice bran	90g
Maize meal	90g
Fish premix	40g

Source: Authors computed results (2020)

Table 5

Treatment 5 (T5) (100% SBM; Control)

Ingredient (s)	Inclusion levels
Fish meal	410g
Soybean residue	410g
Maize meal	90g
Rice brans	90g
Fish premix	40g

Source: Authors computed results (2020)

3.2. Comparative Effects of Soybean Diets on Growth Parameters of *C. gariepinus* fingerlings

3.2.1. Mean length of *C. gariepinus* fingerlings

Table 6 presents the results of the average length of *C. gariepinus* fingerlings for the experimental period (6 weeks) under different treatments. The result indicated that *C. gariepinus* fingerlings subjected to T5 recorded the highest mean length of 7.00 cm; T4 and T3 were 6.91cm respectively, T2 was 6.50cm, while T1 recorded the least length (6.32cm). The cummulative values across weeks during the experiment shows progressive weekly increase in the average length of the *C. gariepinus* fingerlings. There was a significant difference between treatments observed in weeks 1, 4, and 5, while no significant difference were noted in weeks 2, 3, and 6 at 5% probability level. This is in accordance with the investigation of [26], [27] who revealed comparative results in their separate examinations on the development of *C. gariepinus* fingerlings fed with various diets.

Table 6

Weekly mean length of *C. gariepinus* fingerlings for the 42days experiment

Weekly Treatments	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Mean
T1	3.70^{d}	3.25^{a}	4.00^{a}	6.00^{a}	9.00^{a}	12.00^{a}	6.32
T2	3.00^{c}	4.00^{b}	4.00^{a}	7.00^{b}	9.00^{a}	12.00^{a}	6.50
T3	2.50^{b}	4.00^{b}	5.00^{b}	7.00^{b}	10.00^{b}	13.00^{b}	6.91
T4	2.50^{b}	4.00^{b}	5.00^{b}	8.00^{c}	10.00^{b}	12.00^{a}	6.91
T5	2.00^{a}	4.00^{b}	5.00^{b}	8.00^{c}	11.00^{c}	12.00^{a}	7.00
Sig. Level	Sig.	NS.	NS.	Sig.	Sig.	NS.	

Source: Authors computed results (2020); 5% (P<0.05) Sig. Level

3.2.2. Mean width of *C. gariepinus* fingerlings

Table 7 presents the results of the average width of the catfish fingerlings during the 42 days experiment under different treatments. The result indicated that *C. gariepinus* fingerlings subjected to T5 recorded the highest mean width of 2.48cm; T4 and T3 were 2.31cm and 2.15cm respectively, T2 was 1.87cm,; while T1 recorded the least length (1.62cm). The cummulative values across the experimental period (6 weeks) shows progressive increase of the mean values. There was a significant difference between treatments observed in weeks 1 to 5 at 5%

probability level; while there was no significant difference in week 6. This conforms to [28], [29] who revealed comparative outcomes in their separate research investigations on *C. gariepinus* fingerlings development and feeding habits.

Table 7

Weekly mean width of *C. gariepinus* fingerlings for 42days experimental period

Weekly Treatments	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Mean
T1	0.22^a	0.24^a	0.26^a	0.28^a	0.30^a	0.32^b	1.62
T2	0.23^b	0.27^b	0.29^a	0.32^b	0.36^b	0.40^a	1.87
T3	0.25^b	0.30^b	0.32^b	0.38^b	0.42^c	0.48^a	2.15
T4	0.29^c	0.32^d	0.36^b	0.39^c	0.45^d	0.50^a	2.31
T5	0.31^c	0.35^d	0.39^c	0.42^c	0.48^e	0.53^a	2.48
Sig. Level	Sig.	Sig.	Sig.	Sig.	Sig.	NS	

Source: Authors computed results (2020)

3.2.3. *C. gariepinus* fingerlings Average Weight

Table 8 presents the result of the average weight of the juvenile catfish during the 42 days experiment under different treatments. The result shows that *C. gariepinus* fingerlings subjected to T5 recorded the highest mean weight of 0.52kg, T3 and T4 were 0.44kg, respectively; while T1 recorded the least weight (0.39kg). The cummulative values across the experimental period (6 weeks) shows progressive increase in the mean weight values. There was a significant difference between treatments observed in weeks 1 to 6 at 5% probability level. This result is in conformity with the works of [26], [30] and [15] who reported similar results in their respective studies on the growth performance of *C. gariepinus* fingerlings fed with different diets.

Table 8

Average Weight of *C. gariepinus* Fingerlings per Week during the 42 Days Trial

Weekly Treatments	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Mean
T1	0.25^a	0.29^a	0.36^a	0.44^a	$0. 52^a$	$0. 53^d$	0.39
T2	0.36^e	0.30^b	0.37^b	0.46^b	$0. 54^b$	$0. 60^a$	0.51
T3	0.27^b	0.32^c	0.39^c	0.48^c	$0. 55^c$	$0. 63^b$	0.44
T4	0.28^c	0.34^d	0.40^d	0.48^c	$0. 56^d$	$0. 63^b$	0.44
T5	0.36^d	$0. 43^e$	$0. 47^c$	0.58^d	$0. 62^e$	$0. 66^c$	0.52
Sig. Level	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	

Source: Authors computed results (2020)

3.2.4. Survival Rate of *C. gariepinus* fingerlings

Table 9 presents the result of the survival rate of the juvenile catfish during the 42 days experiment under different treatments. The result shows that *C. gariepinus* fingerlings subjected to T5 had the highest survival rate of 97%; an indication that *C. gariepinus* larvae were well adapted to the inclusion levels of the formulated soybean diet in T5; hence the very low mortality rates reported for *C. gariepinus* larvae in T5. This is in line with the study of [12], [31] who detailed comparable results in their separate examinations on the development of *C. gariepinus* fingerling fed with different diets.

Table 9

Survival rate of *C. gariepinus* during the 42days experimental period

Treatments	%
T1	71.0
T2	76.0
T3	83.0
T4	89.0
T5	97.0

Source: Authors computed results (2020)

4. Conclusion

This study evaluated comparative effects of formulated soybean diets on the growth parameters (length, width; weight gain and rate of survival) of juvenile catfish (*C. gariepinus*). The experiment was conducted at the Fisheries Department of the Federal College of Forestry (FCF, Jos), Plateau State, Nigeria. The experimental period was 6 weeks (42days) and the experimental set-up comprised five treatments; each replicated. The results show the differences in graded inclusion levels of the soybean diets and their effects on growth performance of *C. gariepinus* fingerlings. The growth of juvenile catfish (*C. gariepinus)* was significantly affected by the soybean meal (control) (T5).This study strongly recommends increased utilization of the graded inclusion levels of soybean meal (100%) formulated at 44% crude proteins as the central soybean diet for *C.gariepinus* fingerlings in aquaculture systems particularly among smallholders to improve their level of productivity. Also, policies directed towards increased intensification of soybean production in agrarian communities should be implemented. Further research on the feed conversion ratio of *C. gariepinus* fingerlings fed formulated soybean diets in aquaculture systems should be carried out.

5. Acknowledgments

Author B handled the study designed. Author A was responsible for statistical analysis, protocol writing and drafting the first manuscript. Study analysis was handled by Author A and Author B. Author B led the literature search. The final manuscript was read and approved by both authors.

6. References

[1]. ABDELHAMID, A.M., *Fundamentals of fish production and culture*. New universal office, Alexandria, I.S.B.N. 977-438-052-5, 393p, (2009).
[2]. Food and Agriculture organization (FAO), *The state of world fisheries and aquaculture; fish demand and supply in Nigeria, 2000-2015.* FAO fisheries and Aquaculture Department, Rome, (2014).
[3]. PILLAY, T.V.R., KUTTY, M.N., *Aquaculture principles and practices*, Blackwell publishing Ltd., (2005).
[4]. ROUHANI, Q.A., BRIZ, P.J., *Contribution of Aquaculture to rural live hoods in South Africa*. A base line study WRC Project no 1466. Report no. TT238/04, (2004).
[5]. ISYAGI, N.A., VEVERICS K.L., ASIIMWE, R. , DANIELA, W.H., *Manual for the commercial pond production of the African catfish in Uganda*. Kampala, (2009).
[6]. BHUJEL, R.C., *Strategic review on sub Saharan African aquaculture seed supply. Partnership for African fisheries (FAF) Aquaculture working grove*. NEPAD, (2014).
[7]. HECHT, T., *Regional reviews on aquaculture development for sub-Saharan African Countries*, FAO fisheries circular No 10714 Rome, FAO, 96pp. (2005).
[8]. HE, Z.H., QIN, L., WANG, A., JIANG, H. ,WEN, Y., Biology of Moina Mongolica (moinida e,

cladocere) and perspective as live food for marine fish larvae: *A review Hydro-Biology*, 457: 25-37, (2001).

[9]. AYANDA, O., Feeding practices and management. *National workshop on fish deed development and feeding practices in aquaculture organized by fisheries society of Nigeria (FISON) in collaboration with national institution of fresh water fisheries research (NIFFR) and FOA National Special Program for food security (FOA NSPFS)*, pp. 99-104, (2003).

[10]. PARKER, K., *Aquaculture science*, 3rd edition. Cengage learning. Clifton park NJ., USA, pp. 341-381, (2012).

[11]. FERNANDO, C.H., *A Guide to Tropical Fresh Water Zoo Plantation*. Backhuys publicshere leiden, The Netherlands, (2002).

[12]. ADEWUNMI, A.A., Growth performance and survival of *Clarias gariepinus* fingerlings fed different diets. *European Journal of Experimental Biology*, 5(3): 1-5, (2015).

[13]. ORINA, P.S., RASOW, J., OYOO-OKOTH, E., MUNGUTI, J.M., CHARO-KARISSA, H., Combination effect of photoperiod and temperature on growth and survival of African catfish, *Journal of Applied Aquaculture* 28 (1): 17-23 Doi: 10 1080/10454438. 2015.1113763, (2016).

[14]. CONCEICAO, L.E.C., YUFERA, M., MAKORIDIS P., MORAIS, S. , DINIS, M.T., Live feeds for early stages of fish rearing. *Aquaculture research*, 41 (8), 613-640-2109, (2010).

[15]. OLURIN, K.B., IWUCHUKWU, P.O, OLADAPO, O., Larval rearing of African cat fish clarias garipinus fed deccapsulated artemia, wild copepods commercial starter diet. *Africa journal of food science and technology*, 3(8): 182 -185, (2012).

[16]. HAULIHAN, D., BOUJARD, T., JOBLINGS, M., *Food intake in fish*, Black well science LTD, Oxford, (2001).

[17]. ADEBAYO, O.T., QUADRI, I.C., Dietary Protein level and feeding rate for hybrid catfish, *Clarias gariepinus* x *heterobranchusbidorsallis* in homesteads. *Journal of Applied Aquaculture*, 17 (1): 97-106, (2005).

[18]. Federal Department of Fisheries (FDF), *Fisheries statistic of Nigeria*, Newsletter, pp. 2- 45, (2008).

[19]. GAO, Y. AND LEE, J.Y., Compensatory responses of Nile tilapia under different feed deprivation regimes, *Fish Aquatic Science,* 15 (4): 305-311, (2012).

[20]. DADEBO, E., Filter feeding habit of the African catfish, *Journal of Aquatic Science*, 8(1), 15-30, (2009).

[21]. EL-SAYED, A., Tilapia culture in salt water: environmental requirements, nutritional implication and economic potentials. *VIII symposium international of Nutritious as 106 FOA (food and Agricultural organization) 2012 the state of world fisheries and Aquaculture 2012 food and agricultural organization of the United Nations*, Rome, Italy, (2006)

[22]. Food and Agriculture organization (FAO), *Fingerlings production: An overview*. FAO fisheries and Aquaculture Department, Rome Available at http://www.foa.org/docrep/016/12727e/12727e.pdf (accessed on 20th may, 2017), (2003).

[23]. BRUMMETT, R.E., WILLIAMS, M.J., The revolution of aquaculture in African rural and economic development. *Ecological Economics*, 33(2): 193-203, (2000).

[24]. WEBSTER, C.D., LIM, C., *Nutrient requirements and feeding of finfish for aquaculture*. CABI Publishing. UK, (2002).

[25]. ONUWA, G.C., TERNGU, P.D., Comparative effect of Tamarind (*Tamarindus indica L.*) extract and synthetic vitamin as feed additives in Broiler production. *Malaysian Animal Husbandry Journal (MAHJ), 3 (1): 49-52*, (2023).

[26]. ONUWA, G.C. , CHARLES, M.A., Comparative Development of Juvenile Catfish (*Clarias gariepinus*) Fed Commercial Diets and Maggot Meal in Recirculating Aquaculture System. *Malaysian Animal Husbandry Journal (MAHJ), 3 (2):56-60*. DOI: https://doi.org/10.26480/mahj.02.2023.56.60, (2023).

[27]. ADEWOLU, M.A.,ARO, O.O., Growth, feed utilization and hematology of *Clarias grapinus* (Burehell, 1822) fingerlings fed diets containing different levels of vitamin C. *American Journal of Applied Science*, 6 (9): 1675-168, (2009).

[28]. AYELE, T.A., *Growth performance and survival rate of African catfish larvae fed on different types of lives and formulated feeds*. M.Sc. Thesis, university of Natural Resource and life science, Vienna Austria, (2015).

[29]. DADEBO, E., AEMRO, D. AND TEKLE-GIORGIS, Y., *Food and feeding habits of the African catfish Clarias gariepinus (Burchell , 1822)* (Pisces : Clariidae) in Lake, 471–478, (2014).

[30]. TAREKEGN, A.A., *Growth performance and survival rate of African catfish larvae Clarias gariepinus (Burchell 1822) fed on different types of live and formulated feeds.* Master's Thesis, University of Natural Resources and Life Science (BOKU), (2015).

[31]. AJANI, E.K., NWANNA, L.C., MUSA, B.O., Replacement of fishmeal with maggot meal in the diets of Nile tilapia, *Oreochromis niloticus*. *World Aqua Journal*, 35:52-54, (2004).