Prioritizing the Nutrients of Grouper Fish For Feed Formulation using Inversely Proportional to the Variance and Weighted Sum of Z-Scores

Soong Cai Juan, Rosshairy Abd. Rahman, Razamin Ramli

Abstract: ***Grouper fish requires several important nutrients such as crude protein, crude fibre and calcium to maintain its healthiness and growth. However, it is very hard to determine the priority of the nutrients in order to formulate the grouper feed. Therefore, in this paper, the priority of the nutrients is investigated using two methods which are optimal characteristic of inversely proportional to the variance and weighted sum of z-scores. Data was collected from 30 manufactures of grouper fish feed meal and analysis were done by using inversely proportional to the variance and weighted sum of z-scores respectively via SPSS, Statdisk Software and Microsoft Excel. Result shown that weighted sum of z-scores is more appropriate and better method compare with inversely proportional to the variance. The priority of nutrients using weighted sum of z-scores are crude ash, follow by crude protein, phosphorus, crude fat, crude fibre and calcium. This vital information can be considered in such as further study in formulating the nutrients for grouper fish feed.***

Keywords: Grouper, Feed formulation, Weighted sum of Z-scores, Inversely proportional to the variance, Nutrient requirements.

I. INTRODUCTION

Nutrients are fundamental needs for all living beings in terms of healthiness [1] (Gumustekin*et al.,* 2014), to maintain all physical activities (Campbell *et al.,* 2011, Gumustekin*et al.,* 2014) and to survive (Soong *et al*, 2016a, Soong *et al*, 2016b). It is very vital for all living beings to survive with adequate feed simultaneously attain the standard nutrient necessities and day-to-day functions. Thus, to obtain healthy farmed animal, it is important to comprehend the nutrient necessities and nutrient balance. In other words, the nutrient given is equal to the nutrient required to ensure farmed animal can obtain basic nutrients requirement. This objective can be accomplished through consideration on the nutrients priority and eventually motivation to our interest to undertake the grouper fish feed problems as our focus of study. Due to the high market demand of various seafood restaurants, this study chosen these carnivorous groupers (Soong *et al*, 2015, Soong *et al*, 2016a, Soong *et al*, 2016b, Soong *et al*, 2016c), which are more expensive than other fish (Soong *et al*, 2015, Soong *et al*, 2016a, Soong *et al*, 2016b, Soong *et al*, 2016c, Tuburan*et al*, 2001, Daud, 2012, Liu *et al*, 2013, Boonyaratpalin, 1997, Millamena, 2002, Luo *et al*, 2004, Luo *et al*, 2005)and high nutrients (Fao, 2014, Chen & Tsai, 1994, Tuburan*et al*, 2001, Liu *et al*, 2013) and satisfactory taste (Soong *et al*, 2015, Soong *et al*, 2016b, Tuburan*et al*, 2001, Daud, 2012). Nonetheless, it is challenging to find the relevant data because there is no exact data available (NRC, 2011). Many previous studies related to feed formulation has been clarified. One of the approach is Experimental Design (ED) (Agbo*et al*, 2011, Bhosale*et al*, 2010, Dumas *et al*, 2007, Hatlen *et al*, 2007, Shapawi*et al*, 2008, Gunben *et al*, 2014, Shapawi*et al*, 2013, Lohlum*et al*, 2012, Luo *et al*, 2004, Lupatsch*et al*, 2003). ED is a method used to test and examine the feed formulation from various experimentations such as researches by Agbo*et al*, 2011, Shapawi*et al*, 2008, Shapawi*et al*, 2013 and Gunben *et al*, 2014. All their findings confirmed that nutrients can be obtained with compromising growth (Agbo*et al*, 2011,Shapawi*et al*, 2008) or feed utilization efficiency (Agbo*et al*, 2011,Shapawi*et al*, 2008). Nevertheless, these studies used ED which can be categorized as a trial-and-error type (Afolayan&Afolayan, 2008, Onwurah 2005) are tedious and time-consuming. On top of that, ED method is very costly because various experiments and materials are needed in carrying these trials and wasting time. Thus, our approach had shorten time and save cost. To the best of our knowledge, there is no work reported on the weightage of nutrients priorities in feed formulation, including of using ED, inversely proportional to the variance (Chandra, 2005) and weighted sum of z-scores (de bakker *et al*., 2008, Han &Eskin, 2011, Cue Hyunkyu*et al*., 2016, Zaitlen&Eskin, 2013, Evangelou& Ioannidis, 2013). Hence, this research is done using two statistical methods i.e. inversely proportional to the variance and weighted sum of z-scores which able to outline and construct nutrients priority of grouper fish and given its weightage value.Thus, toward achieving this objective, this paper is organized as follows. Methodology is illustrated in the next section, followed by data analysis and discussion. Conclusions remarks and future works are drawn in the last section.

II. METHODOLOGY

Two methods, which are inversely proportional to the variance and weighted sum of z-scores (Z_{SZ}) are described in this section.

Revised Manuscript Received on February 05 2019.

Soong Cai Juan, Faculty of Information Technology and Science, INTI International University, PersiaranPerdana BBN, Puta Nilai, 71800 Nilai, Negeri Sembilan, Malaysia,

Rosshairy Abd. Rahman, School of Quantitative Science, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah, Malaysia

Razamin Ramli, School of Quantitative Science, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah, Malaysia

Both methods are perform similarly where both calculate the weightage; however their characteristics and relationship in determining priority of nutrients in grouper fish feed formulation is investigated thoroughly in this study. Standard deviation and variance is a relevant and most-used measurement of dispersion (Mann, 2013). The value of the standard deviation and variance tells how closely the values of a data set are clustered around the mean (Mann, 2013) or how precision of a value (Chandra, 2005). A larger value of the standard deviation and variance for a data set indicates that the values of that data set are spread over a relatively larger range around the mean (Mann, 2013) or in other word mean low precision (Chandra, 2005) and vice versa. Thus, weight of observation is another measure of precision that is directly related to the precision of a measurement and does not behave in opposite manner as the variance. The weight of a single observation is defined as the inversely proportional to the variance of the observation, i.e., $w = \frac{k}{\sigma^2}$where k is a constant of proportionality. For an observation of unit weight, i.e.,$= 1$, k is equal to variance of the observation. (Chandra, 2005).

Weighted sum of z-scores is another famous method applied in either the fixed effects model meta-analysis (de bakker *et al*., 2008, Han &Eskin, 2011, Cue Hyunkyu*et al*., 2016, Zaitlen&Eskin, 2013, Evangelou& Ioannidis, 2013) or random effect model (Thompson & Sharp, 1999). The weighted sum of z-scores method constructs a new Z-score by calculating a weighted sum of individual z-scores (Cue Hyunkyu*et al*., 2016). The score $Z_i$from study i which $N(0,1)$ under the null hypothesis of no effects. Then, the formula of weighted sum of z-scores is $Z_{SZ} = \frac{\sum w_{SZ,i} Z_i}{\sqrt{\sum w_{SZ,i}^2}}$.

The characteristic of a normal distribution also follow $N(0,1)$ under the null hypothesis of no effects. Weights of multiple studies are combined as formula $w_{SZ} = \sqrt{\sum N_i}$ Where N_i is the sample size of the study (Zaitlen&Eskin, 2010; Cue Hyunkyu*et al*., 2016, Evangelou& Ioannidis, 2013).

In this study, data was collected from 30 manufacturers of grouper fish feedmeal as illustrated in Table 1. These secondary data were collected based on the data published by the grouper fish feed manufacturers. The value in Table 1 represents the component of each nutrients in grouper fish feed for each manufacturer.

Table. 1 The Components of Nutrients in Grouper Feed Meal from Manufactures

	Crude Protein	Crude Fat	Crude Fibre	Crude Ash	Phosphorus	Calcium
1	44	7	3	16	0	0
2	52	8	6	16	1.3	4
3	38	5	3	16	1.5	2.5
4	48	10	3	17	1.8	2
5	52	2	6	10	0	0
6	46	13	2	13	0	0
7	40	5	5	0	0	0
8	38	2	8	0	0.6	0
9	35	7	4	0	1.2	0
10	5	1	0.5	0	0	0
11	11	1.2	5	0	0	0
12	46	14	3	13	0	0
13	12	1.5	3.5	0	0	0
14	52	9.4	2	18	0	0
15	52	20	1	12	0	0
16	43	7	4	16	1.2	0
17	60	8	3	0	0	0
18	47	24	1.8	12	0	0
19	7.8	1.6	0.5	0	0	0
20	4	0.5	1	0	0	0
21	44	10	3	0	1	0
22	47	5.5	0.5	0	0.1	0
23	14.8	1.01	0.5	0	0	0
24	65	5	3.5	0	0.1	0
25	6	0.5	1	0	0	0
26	47	5	3	17	1	0
27	4.7	0.8	0.5	0	0	0
28	9	8	3	0	0	0
29	37	2	8	0	0	0
30	7	0.7	0.7	0.4	0.1	0

The data was analysed using two methods, which are inversely proportional to the variance and weighted sum of z-scores to determine the weightage of nutrients. Inversely proportional to the variance was calculated by using Microsoft Excel while weighted sum of z-scores using Statistical Package for the Social Sciences (SPSS) 13.0 for Windows Version (SPSS Inc, 2005). Subsequently, due to the reason that both inversely proportional to the variance and weighted sum of z-scores can be applied in constructing the weightage of each component to produce feasible solution successfully in a complex problem, thus it is deemed suitable to be adopted in our study of grouper fish feed formulation. Therefore, our study aimed to obtain the weightage of nutrients as presented in the following section.

III. DATA ANALYSIS AND DISCUSSION

In this present study, quantitative descriptive statistics include the mean and standard deviation of crude protein, crude fat, crude fibre, crude ash, phosphorus and calcium are shown as in Table 2. The highest mean was crude protein, which is 33.8100, followed by crude fat, which is 6.1903, the third highest, is crude ash, which is 5.8800, then followed by crude fibre, which is 2.9667. The last two highest mean was phosphorus and calcium, which is 0.3300 and 0.2822 respectively.

Table. 2 Results of Quantitative Descriptive Statistics

	N	Mean	Std Deviation
Crude Protein	30	33.8100	19.55319
Crude Fat	30	6.1903	5.78614
Crude Fiber	30	2.9667	2.12089
Crude Ash	30	5.8800	7.46238
Phosphorus	30	0.3300	0.56272
Calcium	30	0.2833	0.90671
Valid N (likewise)	30		

The result from inversely proportional to the variance method obtained using Microsoft Excel is shown in Table 3. The value in Table 2 represents sum of data, mean and standard deviation. Meanwhile, the value in Table 3 represents variance and inversely proportional to the variance for crude protein, crude fat, crude fibre, crude ash, phosphorus and calcium. Table 4 represents the result for weighted sum of z-scores using SPSS. The weightage of phosphorus is 3.15800937 which is the highest weightage among 6 nutrients while the weightage of crude protein is 0.002615561 which is the lowest weightage using inversely proportional to the variance.

Table. 3 Inversely Proportional to the Variance Using Microsoft Excel

	Crude Protein	Crude Fat	Crude Fiber	Crude Ash	Phosphorus	Calcium
Total Sum∑	1014.3	185.71	89	176.4	9.9	8.5
Variance σ^2	382.3271379	33.479424	4.49816092	55.687172	0.31665517	0.822126
1/ σ^2	0.002615561	0.0298691	0.22231308	0.0179575	3.15800937	1.216358

Table. 4 Result of weighted sum of Z-score

ZCrude Protein	ZCrude Fat	ZCrude Fiber	ZCrude Ash	ZPhosphorus	ZCalcium
0.52114	0.13993	0.01572	1.35614	-0.58644	-0.31248
0.93028	0.31276	1.43022	1.35614	1.72377	4.09906
0.21429	-0.20572	0.01572	1.35614	2.07918	2.44473
0.72571	0.65841	0.01572	1.49014	2.61231	1.89329
0.93028	-0.7242	1.43022	0.5521	-0.58644	-0.31248
0.62343	1.17689	-0.45578	0.95412	-0.58644	-0.31248
0.31657	-0.20572	0.95872	-0.78795	-0.58644	-0.31248
0.21429	-0.7242	2.37322	-0.78795	0.47981	-0.31248
0.06086	0.13993	0.48722	-0.78795	1.54606	-0.31248
-1.47342	-0.89703	-1.16304	-0.78795	-0.58644	-0.31248
-1.16656	-0.86246	0.95872	-0.78795	-0.58644	-0.31248
0.62343	1.34972	0.01572	0.95412	-0.58644	-0.31248
-1.11542	-0.81062	0.25147	-0.78795	-0.58644	-0.31248
0.93028	0.55472	-0.45578	1.62415	-0.58644	-0.31248
0.93028	2.38668	-0.92729	0.82011	-0.58644	-0.31248
0.47	0.13993	0.48722	1.35614	1.54606	-0.31248
1.33942	0.31276	0.01572	-0.78795	-0.58644	-0.31248
0.67457	3.07799	-0.55008	0.82011	-0.58644	-0.31248
-1.33022	-0.79333	-1.16304	-0.78795	-0.58644	-0.31248
-1.52456	-0.98344	-0.92729	-0.78795	-0.58644	-0.31248
0.52114	0.65841	0.01572	-0.78795	1.19064	-0.31248
0.67457	-0.11931	-1.16304	-0.78795	-0.40873	-0.31248

-0.97222	-0.8953	-1.16304	-0.78795	-0.58644	-0.31248
1.59514	-0.20572	0.25147	-0.78795	-0.40873	-0.31248
-1.42227	-0.98344	-0.92729	-0.78795	-0.58644	-0.31248
0.67457	-0.20572	0.01572	1.49014	1.19064	-0.31248
-1.48876	-0.93159	-1.16304	-0.78795	-0.58644	-0.31248
-1.26885	0.31276	0.01572	-0.78795	-0.58644	-0.31248
0.16314	-0.7242	2.37322	-0.78795	-0.58644	-0.31248
-1.37113	-0.94888	-1.06874	-0.73435	-0.40873	-0.31248

The value in Table 4 represents the single value of each crude protein, crude fat, crude fibre, crude ash, phosphorus and calcium for 30 manufactures data. Finally, the average of each nutrients i.e. crude protein, crude fat, crude fibre, crude ash, phosphorus and calcium are calculated to find the weightage.

Ranking of the priority and weightage of nutrients using inversely proportional to the variance and weighted sum of z-scores are shown in Table 5 and Table 6 respectively. Comparison of total nutrients based on these two methods is presented in Table 7. The main nutrients needed in formulating grouper fish feed using inversely proportional to the variance are phosphorus, second important nutrients is calcium, followed by crude fiber, crude ash, crude fat and lastly crude protein. In method of weighted sum of z-scores, the main nutrients needed in formulating grouper fish feed are crude ash, second important nutrients is crude protein, followed by phosphorus, crude fat, crude fiber and lastly calcium.

After consulting with experts, the ranking obtain from weighted sum of z-scores is more reflects real nutrients priority of grouper feed because crude protein is the main source. Thus, the solution from weighted sum of z-scores method is considered in this study.

Table. 5 Results Weightage of Inversely Proportional to the Variance

Ranking	Nutrients	Weightage
1	Phosphorus	3.1580
2	Calcium	1.2164
3	Crude Fiber	0.2223
4	Crude Ash	0.01796
5	Crude Fat	0.02987
6	Crude Protein	0.002616

Table. 6 Ranking Weightage of Weighted Sum of Z-scores in SPSS

Ranking	Nutrients	Weightage
1	Crude Ash	0.9420
2	Crude Protein	0.8756
3	Phosphorus	0.8246
4	Crude Fat	0.7481
5	Crude Fiber	0.7418
6	Calcium	0.5625

Table. 7 Results Comparison of Total Nutrients Based on two Methods

Nutrients	Weightage sum of Z-scores	Inversely proportional to the variance
Crude Protein	0.8756	0.002616
Crude Fat	0.7481	0.02987
Crude Fiber	0.7418	0.2223
Crude Ash	0.9420	0.01896
Calcium	0.5625	1.2164
Phosphorus	0.8246	3.1580
Total Nutrients	4.4012	4.6471

Table. 8 Result of T-test Analysis (One Sample Statistics) using SPSS

	N	Mean	Std. Deviation	Std. Error Mean
Sumof	7	1.29940000	1.373062911	.518968999
Inversely	7	1.32774943	1.860033175	.703026459

T-test for two methods, which are inversely proportional to the variance and weighted sum of z-scores is shown in figure 1. Mean for weighted sum of z-scores and inversely proportional to the variance is 1.2994 and 1.3277 respectively. Standard deviation for weighted sum of z-scores and inversely proportional to the variance is 1.3731 and 1.8600 respectively.

T-test for difference between two independent means is demonstrated in Figure 1. Result shown that fails to reject the null hypothesis. In other words both methods are equally effective. However, when both methods are equally effective, priority of nutrients is the next considered, which is crude protein. This evidence is supported by Muhammadar*et al*. (2016).

Inversely proportional to the variance considers variance, sum of nutrients have very big variance, vice versa. Weighted sum of z-scores provides more reliable weightage that represent real problem. On top of that, the standard error term includes all information, such as sample size and allele frequencies, thus providing optimal performance. This result supported by Cue Hyunkyu*et al.*, (2016), that obtained better result.

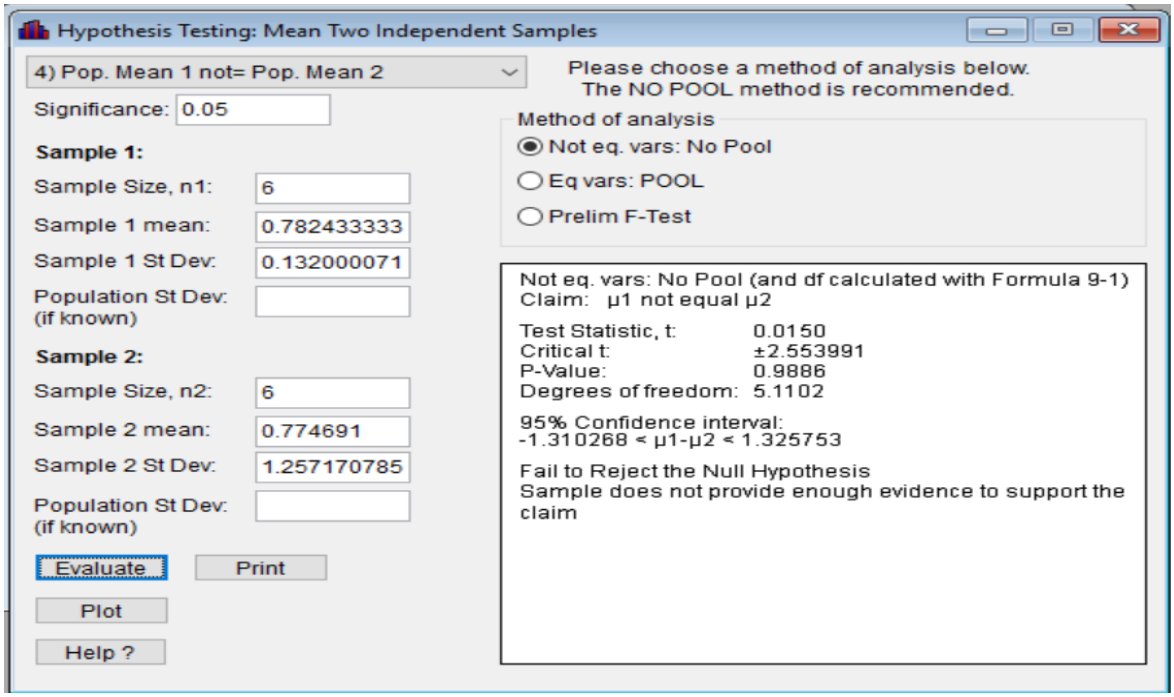

Fig. 1 T-test for Difference between Two Independent Means

IV. CONCLUSIONS AND FUTURE WORK

Two weightage methods, inversely proportional to the variance and weighted sum of z-scores to implement the priority approach in formulating the Grouper feed mix is presented in this paper. A weighted sum of z-scores method proposed can be used, reasonable and applicable to the grouper fish feed formulation compare to inversely proportional to the variance method. Results show that the total nutrients of 4.4012was obtained using weighted sum of z-scores whilst the total nutrients of 4.6471 was obtained using inversely proportional to the variance. It shown both methods are consistent. Thus, it reflects that this method weighted sum of z-scores is capable in its function of determining into potential alternatives and thus, improving the priority in formulating the problem of fish feed. As a conclusion, this research effort aids to unlock frontiers for extensive researchers in-depth on constructing formulation for Grouper fish feed.

ACKNOWLEDGEMENT

This research was funded by a post graduate incentive grants from University Utara Malaysia (15984). We are grateful for the financial support provided for this work. We would also like to thank Dr. Ahmad Daud bin Om, Dr Zainoddin bin Jamari and En. Mohammed Suhaimee bin Abdul Manaf from the Fisheries Department provided real data on the project.

REFERENCES

1. Gumustekin, S., Senel, T., Cengiz, M. A. (2014). "A comparative study on Bayesian optimization algorithm for nutrition problem", Journal of Food and Nutrition Research , 2(12), 952-958.
2. Campbell, N. A., Reece, J. B., Taylor, M. R., Simon, E. J., & Dickey, J. L. (2011). "Biology: concepts and connections (7th ed.)", San Francisco: Pearson Benjamin Cummings.
3. Soong, C.-J., Ramli, R. and Rahman, A. R. (2016a). "Nutrients requirements and composition in a Grouper fish feed formulation", International Soft Science Conference 2016 (ISSC2016), Langkawi, Kedah.
4. Soong, C.-J., Ramli, R. and Rahman, A. R. (2016b). "Investigating Nutrient Requirements of Grouper Fish for Feed Formulation", Journal of Telecommunication, Electronic and Computer Engineering, Volume 8, Number 8, 19-25.
5. Soong, C.-J.;Ramli, R. and Rahman, A.R. (2015). "Fish consumption and track to a fish feed formulation", 2nd Innovation and Analytics Conference &Exhibition 2015 (IACE2015), Kedah.
6. Soong, C.-J.; Ramli, R.; and Rahman, A.R. (2016c). "A standard deviation selection in evolutionary algorithm for grouper fish feed formulation", Proceedings of the 4th International Conference on Quantitative Sciences and Its Application (ICOQSIA), Putrajaya Malaysia, 16 August -18 August 2016, Bangi, Selangor, Malaysia.
7. Tuburan, I.B., Coniza, E.B., Rodriquez, E.M.; Agbayani, R.F. (2001). "Culture and economics of wild grouper (Epinepheluscoioides) using three feed types in ponds", Aquaculture, 201(3-4), 229-240.
8. Daud, A. O. (2012). "PembenihandanpembiaanikanKerapuHarimau", Kuala Lumpur: Dewan Bahasa danPustaka.
9. Liu, Q., Sakamoto, T., Kubota, S., Okamoto, N., Yamashita, H., Takagi, M., Shigenobu, Y., Sugaya, T., Nakamura, Y., Sano, M., Wuthisuthimethavee, S. and Ozaki, A. (2013). "A genetic linkage map of kelp grouper (Epinephelusbruneus) based on microsatellite markers", Aquaculture, 414-415, pp. 63-81.
10. Boonyaratpalin, M. (1997). "Nutrient requirements of marine food fish cultured in Southeast Asia", Aquaculture 151, 283-313.

11. Millamena, O. M. (2002). "Replacement of fish meal by animal by-product meals in a practical diet for grow-out culture of grouper Epinepheluscoioides", Aquaculture 204, 75-84.
12. Luo, Z.; Liu, Y.J.; Mai, K.S.; Tian, L.X.; Liu, D.H.; Tan, X.Y. (2004). "Optimal dietary protein requirement of grouper epinepheluscoioides juveniles fed isoenergetic diets in floating net-cages", Aquaculture Nutrition, 10(4), 247-252.
13. Luo, Z., Liu, Y. J., Mai, K. S., Tian, L. X., Yang, H. J., Tan, X. Y., Liu, D. H. (2005). "Dietary L-methionine requirement of juvenile grouper Epinepheluscoioides at a constant dietary cystine level", Aquaculture, 249, 409-418.
14. FAO (2014). "The state of word fisheries and aquaculture: opportunities and challenges. FAO Fisheries and Aquaculture Department", Food and Agriculture Organization of the United Nations, Rome, 243pp.
15. Chen, H. Y. and Tsai, J. C. (1994). "Optimal dietary protein level for the growth of juvenile grouper, Epinephelusmalabaricus, fed semipurified diets", Aquaculture,119, 265-271.
16. NRC (2011). "Nutrient Requirements of Fish and Shrimp. Board on Agriculture and Natural Resources", National Research Council.
17. Agbo, N.W.; Madalla, N.; and Jauncey, K. (2011). "Effects of dietary cottonseed meal protein levels on growth and feed utilization of Niletilapia", Oreochromisniloticus L. Journal of Applied Science and Environmental Management, 15(2), 235-239.
18. Bhosale, S.V.; Bhilave, M.P.; and Nadaf, S.B. (2010). "Formulation of fish feed using ingredients from plant sources", Research Journal of Agricultural Sciences, 1(3), 284-287.
19. Dumas, A.; De Lange, C.F.M.; France, J.; and Bureau, D.P. (2007). "Quantitative description of body composition and rates of nutrient deposition in rainbow trout (Oncorhynchus mykiss)", Aquaculture, 273(1), 165-181.
20. Hatlen, B.; Helland, S.J; and Grisdale-Helland, B. (2007). "Energy and nitrogen partitioning in 250g Atlantic cod (Gadusmorhua L.) given graded levels of feed with different protein and lipid content", Aquaculture, 270(1-4), 167-177.
21. Shapawi, R.; Mustafa, S.; and Wing-Keong, N. (2008). "Effects of dietary fish oil replacement with vegetable oils on growth and tissue fatty acid composition of humpback grouper", Cromileptesaltivelis (Valenciennes). Aquaculture Research, 39(3), 315-323.
22. Gunben, E.M.; Senoo, S.; Yong, A.; and lohlum, R. (2014). "High potential of poultry by-product meal as main protein source in the formulated feeds for a commonly cultured grouper in Malaysia (Epinephelusfuscoguttatus)", SainsMalaysiana, 43(3), 399-405.
23. Shapawi, R.; Ebi, I.; Yong, A.; Chong, M.; Chee, L.K.; and Sade, A. (2013). "Soybean meal as a source of protein in formulated diets for tiger grouper, epinephelusfuscoguttatus juvenile", Part 11: Improving diet performances with phytase supplementation. Agricultural Sciences, 4(6A), 19-24.
24. Lohlum, S.A.; Forcados, E.G.; Agida, O.G.; Ozele, N.; and Gotep, J.G. (2012). "Enhancing the chemical composition of balanitesaegyptiaca seeds through ethanol extraction for use as a protein source in feed formulation", Sustainable Agriculture Research, 1(2), 251-256.
25. Lupatsch, I.; and Kissil, G.W. (2003). "Defining energy and protein requirements of gilthead seabream (sparusaurata) to optimize feeds and feeding regimes", Israeli Journal of Aquacuture-Bamigdeh, 55(4), 243-257.
26. Afolayan, M.O.; and Afolayan, M. (2008). "Nigeria oriented poultry feed formulation software requirements", Journal of Applied Sciences Research, 4(11), 1596-1602.
27. Onwurah, F.B. (2005). "Excel feed formulation and feeding models", Proceedings of the 1st International Technology, Education and Environment Conference. African Society for Scientific Research (ASSR), pp. 192-199.
28. Chandra, A. M. (2005). "Higher surveying", New Delhi: New Age International (P) Limited.
29. De Bakker, P. I. W., Ferreira, M. A. R., Jia, X., Neale, B. M., Raychaudhuri, S. & Voight, B. F. (2008). "Practical aspects of imputation-driven meta-analysis of genome-wide association studies", Human Molecular Genetics,17(2), R122-R128.
30. Han, B. &Eskin, E. (2011). "Random-effects model aimed at discovering association in meta-analysis of genome-wide association studies", The American Journal of Human Genetics, 88, 586-598.
31. Cue-Hyunkyu, L., Seungho, C., Ji-Sung, L. & Buhm, H. (2016). "Comparison of two meta-analysis methods: Inverse Variance-Weighted Average and Weighted Sum of Z-Scores", Genomics Inform, 14(4), 173-180.
32. Zaitlen, N. & Eskin, E. (2010). "Imputation aware meta-analysis of genome-wide association studies", GenoetEpidemiol, 34(6), 537-542.
33. Evangelou, E. & Ioannidis, J. P. A. (2013). "Meta-analysis methods for genome-wide association studies and beyond", Nature Reviews Genetics, 14, 379-389.
34. Mann, P.S. (2013). "Introductory statistics", (8th Ed.) New Jersey: John Wiley & Sons Inc.
35. Thompson, S. G. & Sharp, S. J. (1999). "Heterogeneity in meta-analysis: A comparison of methods", Statistics in Medicine, 18, 2693-2708.
36. SPSS Inc (2005). "SPSS 13.0 for windows student version: For Microsoft Windows XP, 2000, Me, and 98", USA: Prentice Hall.
37. Zaykin, D. V. (2011). "Optimally weighed Z-test is a powerful method for combining probabilities in meta-analysis", Journal of Evolutionary Biology, 24(8), 1836-1841.
38. Muhammadar, AA., Mazlan, A. G., Samat, A., Muchlin, Z. A. & Simon, K. D. (2011). "Crude protein and amino acids content in some common feeds of tiger grouper (Epinephelus fuscoguttatus) juvenile", Aquaculture, Aquarium, Conservation & Legislaton International Journal of the Bioflux Society, 4(4), 499-504.