



PRACTICAL LIVESTOCK FEED FORMULATION HANDBOOK

For Agric. Students,
Livestock Farmers/
Nutritionists &
others!

BY

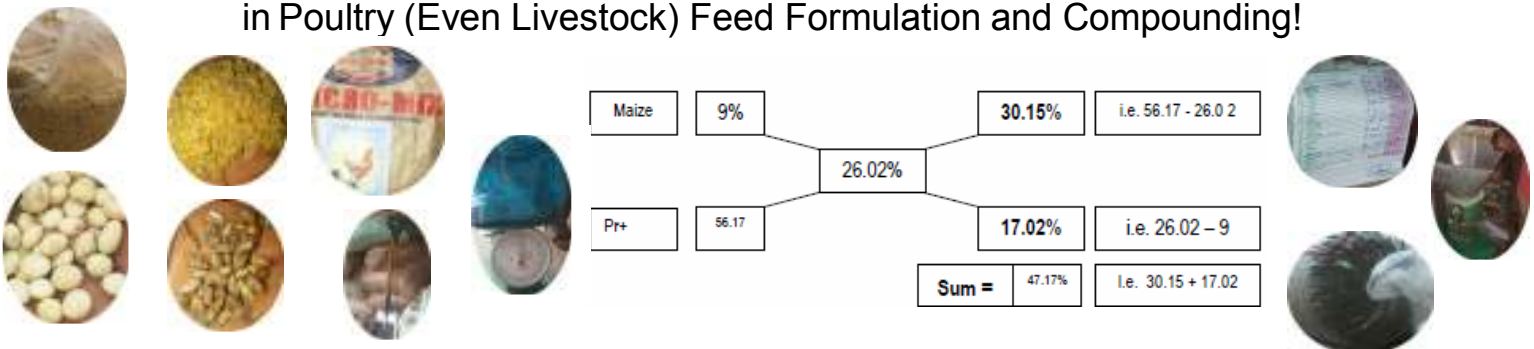
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TAYO SOLAGBADE

B.Sc Agric. Extension Services(Ib)

(SELF-DEVELOPMENT ACADEMY)

This Handbook reveals **ALL The Secrets** needed for **ANYONE** to become **Proficient** in Poultry (Even Livestock) Feed Formulation and Compounding!



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- Detailed notes, worked examples, practical tips, and illuminating insights into the science of feed formulation using the Pearson Square computation technique.
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I

TABLE OF CONTENTS

	<u>Page No.</u>
1.0 ABOUT THE AUTHOR	- 4 - 6
1.1 CREDITS AND ACKNOWLEDGEMENTS	- 7
2.0 INTRODUCTION	- 8 - 11
2.1 WHO SHOULD READ THIS HANDBOOK?	
2.2 CAUTIONARY NOTE	
2.3 CORRECTIONS, COMMENTS, AND HELP	
2.4 THE SELF-DEVELOPMENT ACADEMY	
3.0 FEEDS	- 12 - 16
3.1 FEED INGREDIENTS	
3.1.1 ENERGY SOURCES (CARBOHYDRATES)	
3.1.2 PROTEIN SOURCES	
3.1.3 MINERAL SOURCES	
3.1.4 VITAMIN SOURCES	
4.0 TECHNIQUES FOR RATION FORMULATION	- 17 - 57
4.1 INITIAL CONSIDERATIONS	
4.2 KEY CONSIDERATIONS FOR RATION FORMULATION	
4.2.1 SOME RULES TO KEEP IN MIND	
4.2.2 TYPES OF FEED COMPONENTS	
4.2.3 FEED ENERGY LEVEL	
4.3 FIXED INGREDIENTS OR FIXED FACTOR COMPONENTS	
4.4 DERIVING THE FEED FORMULA	
4.5 INCORPORATING OTHER INGREDIENTS IN RATIONS TO OPTIMIZE COSTS	
4.6 ENSURING AMINO-ACID BALANCE IN THE RATION	
4.7 FEED MIXING	



II

4.8 SAMPLE RECOMMENDED RATION FORMULARS

4.9 CAUTIONARY NOTES

5.0 FINAL NOTES - 58 - 69

5.1 SOME QUESTIONS/ISSUES TO PONDER

5.2 PROGRAMME OF VACCINATION AND PREVENTION OF POULTRY DISEASES

5.2.1 VACCINATION REGIME

5.2.2 MEDICATION REGIME

5.3 ESSENTIAL FEATURES OF RATIONS FOR DIFFERENT POULTRY GROUPS

5.3.1 BROILER STARTER RATION

5.3.2 BROILER FINISHER RATION

5.3.3 CHICKS STARTER RATION (0 – 6TH WEEK OF LIFE)

5.3.4 GROWERS' RATION

5.3.5 LAYERS' RATION

5.4 THE AUTOMATED RATION FORMULATION SPREADSHEET PACKAGE

5.5 ADDITIONAL REFERENCE TABLES OF VALUES

TABLE 5.5.1: ESSENTIAL AMINO ACID CONTENT OF FEEDING STUFFS

TABLE 5.5.2: ENERGY AND PROTEIN CONTENT OF FEEDING STUFFS

5.6 HISTORICAL RECORDS OF RATION FORMULAS USED IN SFRF

6.0 LEGAL NOTICE AND DISCLAIMER - 70



1.0 ABOUT THE AUTHOR

Tayo Solagbade holds a B.Sc degree in Agricultural Extension Services from the University of Ibadan. He graduated top of his class - with Second Class Upper Division honors - in 1992. While in the university, he was an active member (and at a point Sales Coordinator) of the Student's Farm Research Foundation (SFRF) - an innovative, *self-funding* farm research oriented student group. SFRF was dedicated to helping members gain in-depth understanding of livestock management by exposing them to real-life experiences, which often involved experimentation with feeding, medication/vaccination etc.

Tayo observed his National Youth Service year (1992/93) in Vatsa village on the outskirts of Niger state. During this period he was involved in teaching Agricultural Science and Mathematics/Physics at Senior Secondary School level in two schools – Government Girls Science Secondary School and Government Day Secondary School. After completing his service year, he initially worked for 6 months as a Trainee Sales Coordinator in Produce Extract Limited, Matori, Lagos where he got involved in the day to day running of the wine manufacturing plant. In that plant, overripe pawpaw fruits were innovatively processed into a popular range of fruit-based wines (e.g. Carta Blanca) sold across the country.

In October 1994, Tayo joined Guinness Nigeria Plc as a Management trainee in the Technical Function. About 12 months later was redeployed to Benin Brewery as a Shift Brewer. Over a 3-year period, Tayo worked in the Production and Packaging Departments of the brewery where his performance led - among other things - to his repeat nominations to act as Training and Technical Development Manager (twice) in 1998.

In June 1997, Tayo sat and passed the Institute of Brewing (UK) Associate Membership Examinations – earning the AME certification. Later that same year, Tayo wrote a paper titled “*Statistical Process Control and Target Setting*” and became the first manager from Guinness Nigeria to participate in the Nigerian Institute of Management's (NIM) Young Managers' competition. He presented the paper (and won 2nd



place) at the Zonal finals Ibadan. He later went on to place 5th at the National finals in Lagos (December 1997). Between 1997 and 2000, Tayo became widely recognised in Guinness for successfully developing automated Lotus 1-2-3-spreadsheet packages for data management/reporting purposes in the Production department of Benin brewery. The packages were not only formally adopted for use, but (also in preparation for the rollover to year 2000), were sent over to the UK for conversion to Microsoft® Excel-compatible format.

In September 2001, Tayo was promoted Training and Technical Development Manager (TTDM) and almost immediately nominated to attend a 6 week International Brewing Course in the United Kingdom. Four months after returning from the UK/resuming as Training manager, he was nominated to act as Production Manager for a five-week period. Despite this sudden and unexpected demand to act as a departmental head (having left that same department only some months earlier), Tayo successfully completed the secondment - getting commendations from senior management in the process. In August 2001, Tayo successfully developed a custom automated Training Records database management package for Benin brewery. The package was developed to meet the requirements of the then impending ISO 9002 certification audits.

Over a 7-year period, Tayo successfully employed Self-Development techniques to give himself a consistent edge in Guinness Nigeria Plc. This fact was well attested to by his bosses, colleagues and reports during a departmental send-off party organized in his honour on Wednesday 19/12/01. *Tayo resigned his appointment in Guinness Nigeria Plc with effect from December 2001.* A passionate desire to actualize his dream of owning an integrated Poultry and Catfish Rearing/Breeding farm – as well as the need to be “free” to further develop his ideas on the application of Self-Development principles for successful living made him decide to leave – the promise of a bright future in Guinness notwithstanding¹.

¹ Incidentally, just before he left in December 2001, Tayo successfully finished his most recent management research paper titled “**Self- Development As A Tool For Achieving Career Advancement** (A Practical Guide Based On Experience)” which he has already published electronically in Adobe Acrobat PDF format. In September 2002, he delivered – on formal invitation by the D.G, a one hour lecture on the paper to managers and directors at the Centre for Management Development, at Shangisha, Lagos.



All through the time he spent in the breweries, Tayo had never lost touch with developments in the area of Livestock farming. He had maintained close contacts with former classmates in active practice, and also made new acquaintances like *Ademuyiwa Adediran (The Fish Man™)* who is a pioneer of *catfish/ornamental fish breeding/rearing* in Nigeria².

Tayo now runs the Self-Development Academy, a mobile/freelance creative training outfit dedicated to helping people achieve perpetual successes in their personal and work lives, by teaching them practical Self-Development techniques. He decided to write this handbook, following his discovery that a need still exists for an easy to understand body of information on the subject of Feed formulation. He is also currently using his programming skills to develop custom computer spreadsheet solutions for individuals and businesses. An example is his **Automated Ration Formulation Spreadsheet Package** designed to make the process of computing the various ingredients in a ration quicker, easier and more accurate.

Tayo believes the availability of an automated package will not detract from the usefulness of a handbook on feed formulation. This is because only a person with a sound understanding of the basis of feed formulation (nutrient balancing in diets, nutrient requirements in different birds etc) would be able to use the package. His hope is that persons who attend his seminars and coaching programs, including those who decide to set up Poultry Farm(s) for instance, will find the handbook to be a useful and **affordable Information Product** on one of the most critical aspects of poultry management i.e. feed formulation.

Tayo is happily married with children.

² Tayo successfully completed an apprenticeship of sorts from May to Dec. 2002 on Muiyiwa's specialized fish rearing farm at Abesan Estate Ipaja.



1.1 CREDITS AND ACKNOWLEDGEMENTS

In producing this handbook, I have drawn heavily from notes and knowledge I acquired during my 5 years of study as an undergraduate of Agricultural Extension Services in the University of Ibadan. Especially useful were the 3 years I was a member (and at one time “Sales Coordinator”) of a very innovative campus group called “the Student’s **Farm Research Foundation – SFRF**³”.

On many occasions – as Sales Coordinator – I had to visit various farms/feed mills in order to purchase different poultry feedstuff for use in compounding rations formulated by the then Project Coordinator – Kunle Bayewu. The challenging experiences that resulted from carrying out my assignments back then really gave me deep insight into the essential requirements for proper ration formulation.

At this point, I must acknowledge and thank Kunle Bayewu for putting together a Poultry Feed Formulation Handout – which he made available to interested SFRF members just before he left in 1991. The handout became a bible of sorts for me later on, and I successfully used it - in combination with other books/literature (some from the internet) - to consolidate my understanding of poultry ration formulation.

Self-Development/Performance Enhancement Specialist & Multipreneur

**Sole Agent For Burt Dubin's Speaker Mentoring Service (www.speakingsuccess.com) In Africa*

Mobile: 234-803-302-1263

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³ A student’s organization comprising mainly Veterinary Medicine and Agriculture and Forestry department students. Members were typically exposed to practical livestock (poultry, rabbits etc) management techniques including feeding, feed formulation/ compounding, disease prevention and control etc. The Supplies Coordinator was responsible for purchasing needed feeds/other materials for running the farm. Substantial income was generated by the foundation through sales of pullets; broilers, cockerels, old layers/eggs, rabbits etc produced on its farm - hence its self-funding status.



2.0 INTRODUCTION

Today in Nigeria, a lot of people are gradually finding their way back to Agricultural activities in general and Poultry farming in particular. This is a good development which if continued should see this country return to self-sustenance in food production in the near future. Poultry farming, though potentially lucrative, can be fairly risky if a farmer is not diligent. Some farmers have recorded severe losses by way of disease outbreaks or dismal productivity resulting from poor feeding among other things.

Apart from the hygiene condition of the environment where poultry are kept, the types of feeds - and manner of feeding - that the birds are subjected to can prove quite critical in determining the ultimate output achieved by a farmer whether in terms of eggs laid, or bird sizes/weight at point of sale. Someone recently made an interesting observation to me about practicing poultry producers here in Nigeria. He pointed out many of these farmers lack formal training in poultry management. However, despite this seemingly serious inadequacy, they successfully feed/manage their birds for profit – which is why they remain in business even today! Now if that is possible, imagine how much better off they would be in terms of farm productivity (and profits) if they developed a better knowledge/understanding of poultry feedstuffs and ration formulation/compounding!!

Feeding is one critical element that determines how well poultry or any other farm animals perform. It impacts not only on growth rates, but also on the disease resistance of the birds (though protection is also afforded the birds through vaccination/medication regimes). To put it another way, it has been acknowledged that 'Diet is an important component of the environment under all climatic conditions. The potential of the bird cannot be attained if the environment, and notably the diet, is substandard.

This is why the publication of this Practical Poultry Feed Formulation Handbook could not have come at a better time. It has been written in very simple language, drawing extensively from the author's personal



notes, records and experiences. The handbook also offers some tested and proven pre-formulated poultry ration formulas that can be immediately put to use by a farmer.

2.1 WHO SHOULD READ THIS HANDBOOK?

This handbook will prove a much consulted reference not just for poultry farmers, but also for students - and teachers - of general agriculture, animal/poultry science, animal nutritionists as well as aspiring livestock farmers/ entrepreneurs.

2.2 CAUTIONARY NOTE

A general note of caution is appropriate at this point. In using this handbook, there is the expectation that a farmer will take pains to purchase feedstuff of the right quality if he/she wants to get the results promised in the recommended rations. For instance, a weevil-infested batch of maize will contribute significantly less energy/nutrients to a diet (even if a good prescribed formula is followed) than one that is in good condition.

Also, many experienced poultry/livestock farmers know that certain feedstuffs are not used in excess amounts for compounding animal rations due to detrimental effects that result. Effort has been made in this handbook to give as much detail as possible of the more common types of potentially problematic ingredients. However, the new or less experienced farmer would be well advised, to seek the assistance of more experienced colleagues and/or practicing animal nutritionists when in doubt.

I will however end by saying that for as long as the poultry farmer does not stray beyond the limits recommended in this handbook (and other guide books), it is unlikely that any ration compounded would be detrimental in any way to the animals fed on it.



2.3 CORRECTIONS, COMMENTS, AND HELP

Every effort has been made to ensure the accuracy of this book (including the contents of the numerous tables of values provided in it). The Self-Development Academy provide corrections and additional content for its books through e-mail and its Cost-Saving Farm Biz Ideas website in www.iff.spontaneousdevelopment.com. If you have any comments, questions, or ideas regarding this book or the subject covered, please send them to us. Send e-mail to ffhb@tksola.com.

Finally, note that support or assistance with understanding or making use of the handbook will be **readily and freely offered** to anyone (who purchases the handbook and requests it) through either of the above addresses. In addition, the Self-Development Academy will organize and facilitate seminars on feed formulation should the need for it be identified and adequate numbers of persons indicate their interest.

2.4 THE SELF-DEVELOPMENT ACADEMY

I founded the Self-Development Academy (in January 2002), as a mobile/freelance creative training outfit committed to helping people achieve perpetual successes in their personal and work lives, by teaching them practical Self-Development techniques. Through the Development Academy, I continue propagating my ideas and convictions about the benefits derivable from diligent application of Self-Development principles to achieve success in any area of endeavour.

The academy offers a growing library of information products on various topics relating to acquisition of knowledge or skills aimed at helping anyone develop him/herself towards achieving any objective(s). A summary of the learning events offered by the academy and/or the list of available information products is available at www.tksola.com. You can also request for a custom learning event to be organized for you.

Lastly, I sincerely hope all that read this handbook find it useful and beneficial to them in their personal, academic or business pursuits. I would readily welcome any suggestion for improvement of this handbook.

TAYO SOLAGBADE

The Spontaneous Coach™



MORE FROM TAYO SOLAGBADE (Including A Special Article Contribution Offer)

I have over the years published online, a growing library of writeups (articles, blog posts, and information products) on entrepreneurship, marketing, employee career development, workplace performance improvement, farm business best practice systems development among others. As part of my repositioning efforts, I'm currently moving over 170 of my website based writeups into my new Performance Enhancement blog (<http://www.sdacademy.org>), where I aim to concentrate new updates on my primary areas of focus.

If you own an authority website or run a high profile print publication related to my areas of focus, get in touch if you'd like me to contribute a short (500 to 750 word) write-up. By "guest posting" on your site (or contributing a piece in your print publication), I believe I can add useful value to your readers, while at the same time cementing my credibility via increased name recognition. It would be a win-win for us.

You may wish to browse through my websites and blogs.

TK Solagbade

Monday 23rd July 2012 @ 10.00a.m

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Mobile: 234-803-302-1263

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<http://www.linkedin.com/in/tayosolagbade>

<http://www.facebook.com/tayo.solagbade>

<http://www.youtube.com/TKSolagbadeSDAc> (Demonstration & Tutorial Videos)

Platinum Quality Author at the Ezine Articles Directory:

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Self-Development/Performance Enhancement Specialist - Tayo Solagbade- works as a Multipreneur, helping individuals/businesses develop and implement strategies to achieve their goals, faster and more profitably. Depending on his availability, Tayo accepts invitations to deliver customisable talks and keynote speeches on topics relating to his areas of experience based expertise and interest. Visit www.tksola.com to learn how you can invite Tayo, to speak at your next meeting/event.

As a multipreneurial freelance writer, Tayo Solagbade's versatility, and use of in-depth research (on and off the Internet), equip him to quickly produce 100% original - and easy to understand – write-ups. When he's not amazing clients with his superhuman writing skills (wink), Tayo works as the creative force behind:

a). The Self-Development Nuggets blog:

<http://www.spontaneousdevelopment.com/sdnuggets>

b). The Public Speaking IDEAS blog:

<http://www.spontaneousdevelopment.com/blog>



3.0 FEEDS

Estimates have shown that feeds represent 70 – 75% of the total cost of livestock production - especially poultry and piggery production. Ration formulation is a technique that enhances adaptation of local feed stuffs in compounding rations. It takes into consideration 2 basic concepts:

- a. The specific nutrient requirement of different animals.
- b. The ingredients of the feed itself.

There is also some specific requirement dependent on the type of animal in question: whether it is monogastric or ruminant. A ruminant animal is one that brings back food from its stomach and chews it again, and which is able to digest cellulose (a complex carbohydrate) with the aid of microorganisms, which live in its intestines e.g. Cow and sheep. A monogastric is one that can is incapable of digesting complex carbohydrates e.g. poultry etc.

Nutrients are chemical substances found in food materials (feeds), which are required for the growth, maintenance, production and health of animals. A balanced ration is one that supplies these nutrients in the right amounts and proportions relative to each other. When rations are well balanced, a smaller quantity is required for most economic efficiency, while greater amounts of a poorly balanced ration will be required to meet the specific production purposes in livestock. These greater amounts constitute expensive wastes, which could have been saved if the rations had been well balanced in the first place.

Poorly balanced rations depress appetite in animals leading to poor performance, and high susceptibility to infection and disease. In carrying out ration formulation, we study the daily nutrient requirements of different animals, and compare with the composition of available feed ingredients. We then manipulate the latter to meet the needs for satisfactory productivity either in terms of meat, milk or egg production.



3.1 FEED INGREDIENTS

Feed ingredients are basically grouped as follows:

3.1.1 ENERGY SOURCES (CARBOHYDRATES)

The energy in poultry diets is derived mainly from cereals. Typically, maize, millet, sorghum, rice and wheat are locally available/used in compounding poultry rations. Others include Guinea Corn as well as non-cereals like Cassava and Sweet Potatoes. Incidentally, it has been reported that non-cereal carbohydrates like Cassava can be used for up to 5- - 60% of growers' and layers' diets without detrimental effects on the performance of the birds. Studies have also shown that sweet potatoes and cassava have better metabolisable energy values than coco yam, and yam, when they are included in chick diets. The downside to their use is however the need for some processing as well as their relatively lower protein content.

Different types of oils usable in supplying energy in poultry rations include palm oil, melon-seed oil, groundnut oil, and palm-kernel oil. Others sources are Lard (a firm white substance made from the melted fat of pigs and used in cooking) and Molasses (a thick, dark sweet liquid obtained from sugar while it is being refined – though this has been found to be a poor substitute for maize in chick diets). There are also other by-products like biscuit crumbs, broken wheat (wheat offal), broken rice (rice bran) etc. Apart from supplying energy, they are also required for body heat maintenance. Carbohydrate deficiency in the diet will cause poor growth rates in chicks.

Some industrial by-products that are locally utilized for supplying energy in feed formulation in Nigeria include wheat offal, rice husk, dried brewer's grain and cocoa husk. Other by products include yam peels and cassava peels.



3.1.2 PROTEIN SOURCES

- a. **Plant origin:** GroundNut Cake(GNC), Soya Bean Meal(SBM), Cotton Seed Cake, Whole Soya Beans, Palm Kernel Cake (PKC), Rubber Seed Meal (RSM), Sunflower Seed Cake.
- b. **Animal origin:** Blood Meal; Meat Meal, Fish Meal (FM), Brewer's Dried Grain (BDG) i.e. Spent Grains, yeast, hydrolysed feather meal, chicken offal etc

It is note worthy that proteins of animal origin have higher protein content between 80 – 85% and a higher quantity of the most limiting amino acids (AA) i.e. have higher Methionine and Lysine content than those of plant origin. Protein is used for synthesis of body tissues making it useful in growth, body repairs and egg formation processes. Its deficiency can lead to poor growth/feathering and development of vice habits among the birds.

It is pertinent to note here that the component parts of proteins i.e. Amino Acids (AAs) – rather than protein itself – are of greatest nutritional importance to poultry feeding. About 20 AAs exist – some can be synthesized readily and sufficiently in the fowl's body (Non-Essential AAs) and some cannot (Essential AAs). Table 3.1.2 below gives a summary of all the Amino Acids:

Table 3.1.2

ESSENTIAL AMINO ACIDS		NON-ESSENTIAL AMINO ACIDS
Arginine	Methionine	Alanine
Cystine	Phenylalanine	Aspartate
Histidine	Threonine	Glycine
Isoleucine	Tryptophan	Hydroxproline
Leucine	Tyrosine	Proline
Lysine	Valine	Serine



It has been said that in order to achieve reasonable amino acid balance, the amino acid content of a ration should be calculated or analysed. Based on the analysis, Fish Meal for instance, has been found (like other intact proteins) to be rich in all amino acids, and as such can be used to rectify amino acid deficiency. Also, it offers the additional benefit of furnishing minerals, vitamins, and possibly essential fatty acids.

Synthetic amino acids make it possible to achieve good amino acid balance in compounded feeds, without resorting to the use of animal proteins. However it is fairly common practice for synthetic amino acids (e.g. feed grade methionine) to be used in combination with intact proteins - especially since the former tend to be expensive.

3.1.3 MINERAL SOURCES

Minerals enable skeletal tissue development and maintenance in poultry. They also make up a good proportion of the egg and help physiological functions. Mineral sources that are available locally are oyster shell, seashells and limestone as sources of Calcium (Ca) while bone meal or defluorinated rock phosphate serve as sources of Phosphorous (P). A gradual rise over the years in the price of bone meal has resulted from the reduction in the number of cattle slaughtered, and a consequent increase in bone consumption by humans – due to prices of meat rapidly becoming unaffordable to the majority of the population.

The foregoing situation resulted in attempts to explore the use of other sources such as Rock phosphate. Available results caution that in using this source, the attention should be paid to dangers posed by its fluoride content. Other sources of minerals include fertilizers e.g. single phosphate and super phosphate. Deficiency of mineral salts in diets can reduce egg production, and has been suspected to predispose birds to cannibalism.



3.1.4. VITAMIN SOURCES

The discovery of vitamins made intensive poultry farming possible. This is a situation where birds are successfully kept for long periods without access to pasture or direct sunlight. Vitamins are organic compounds not synthesized in the body, but required in small amounts. They function mostly as co-enzymes or regulators of metabolism. The sources of vitamins available locally include some plant sources e.g. Alfalfa, Luru (dried leaves of *Adansonia digitata*) and Eupatorium, which are sources of carotene and palm oil. Vitamins are given in synthetic form, which is often preferred to the natural sources, due to the former's standard quality, and proven effectiveness.



4.0 TECHNIQUES FOR RATION FORMULATION

4.1 INITIAL CONSIDERATIONS

In explaining how to formulate and compound feed, some real-life examples will be used. Firstly, however, it is of paramount importance that the following percentages of proteins in some key ingredients are known:

Table 4.0

Ingredient(s)	Protein (%)
Groundnut cake(GNC)	48
Wheat Offal(WO)	17+
Maize	9
Cassava flour	3
Palm Kernel Cake(PKC)	20

Note: (a). Protein will sometimes be abbreviated as Pr^r in certain parts of the text. (b). Wheat Offals are used as binding agents

The basic problem of nutrition is to find the solution of an equation, which basically states that the ration fed is equal to the determined requirement of the animal for nutrition. But just thinking about it one realizes that this rather deceptively simple statement leaves many questions unasked on either side of the equation.

In brief for example, it may be necessary to know:

1. Have the requirements been adequately determined?
2. Do they relate to the degree of activity or productivity, which is going to be expected?
3. What amount of this ration will the animal eat in a specific time - usually a period of 24 hours?
4. Will this intake provide the requirement estimated/determined?



5. Are feedstuffs available to provide the requirements specified for energy, Amino Acids, Vitamins and minerals?
6. Can they be mixed together to give a ration of good keeping quality that can be handled easily and which will be readily eaten by the stock for which it has been made – ***without negative or harmful effects?***
7. Can the formulated ration be produced at a favorable cost?

The person formulating the ration, whether he is a professional nutritionist working for a feedstuff's company or a poultry farmer planning to mix a formula by substituting home grown/locally available ingredients has to have all this information.

Different people may put different levels of emphasis on each of the questions listed earlier. The nutritionist will try to strike the best balance (between the sides of the equation) in respect of common units of energy in protein. The compounder is more likely to be concerned with the relative cost of different ingredients, which might be used in the compounding. The farmer on his part will be keen to ascertain if the animals will readily –and repeatedly - eat the ration, *AND* if it does the job for which it has been compounded. The balancing of poultry feeds or rations is a complex process because it involves:

- a. Balancing between the main classes of nutrients within the ration and
- b. Balancing between the nutrient groups – especially between the various Amino Acids.

Someone once said “In a sense, it is like deriving sets of simultaneous equations and then solving them to get the appropriate proportion of the ingredients” (actually, some people really do that i.e. use simultaneous equations to formulate rations, though it is hardly a “friendly” method!). However, the method covered – and recommended - in this handbook is mainly diagrammatic, making for quicker/easier understanding and usage.



This technique is known as the “**Pearson Square**”. With the increasing advancement of technology the rather cumbersome process of deriving ration formulas via manual calculations using the Pearson Square has been made much easier with the computer. A number of specially developed computer applications now exist in the market, which can be reliably used to arrive at effective livestock rations formulas. One of them is the Automated Excel Spreadsheet Package I developed to automatically formulate rations using the Pearson Square method thereby eliminating the need for the farmer to do ANY calculations of his own!

4.2 KEY CONSIDERATIONS FOR RATION FORMULATION

Now, in order to balance or formulate a ration, one needs to know the target animal i.e. whether it is a day-old chick, grower, weaner, layer, cockerel etc. It is also important to ascertain the:

- a. Minimum protein requirement,
- b. Maximum fibre content
- c. Minimum energy requirement either as DE (i.e. Digestible Energy) or ME (i.e. Metabolisable Energy) in kcal/kg DM (i.e. Digestible Matter) of the ration (0.8 D.E = ME approximately)
- d. Minimum requirement for other minor nutrients like Calcium, Phosphorous, Iron, Potassium etc
- e. Feedstuff available and any anti-nutritional factors present in them such as trypsin in Soyabean Meal and Gossypol in Cotton Seed Meal.

For this exercise. Pearson Square takes care of one nutrient at a time, with emphasis being laid on the crude protein (C.P). From the table of requirements, the minimum C.P required in the feed for broilers is 23 – 25%. In some cases, C.P content of 20 – 21% has been used but the minimum C.P target is put at 22%.

There are 2 key ingredients required, and these are Carbohydrates (CHO) and Proteins. In Nigeria, maize is the standard source of CHO and Groundnut Cake (GNC) is the standard plant protein.



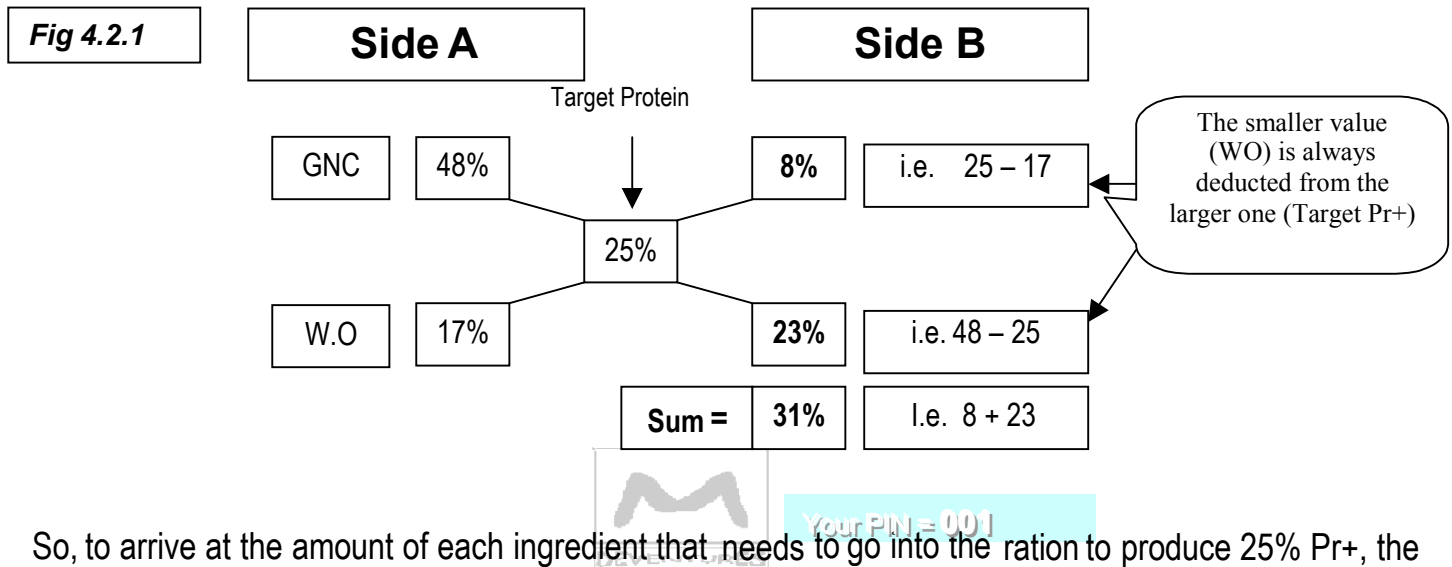
Example 4.2.1

A man has GNC and Wheat Offal. He wants to compound a 25% Pr⁺ ration. To know the proportion of ingredients mixed, one must know the protein (Pr⁺) content and the Pearson Square is used – a technique by which you arrive at the desired nutrient level for the resulting ration through utilization of 2 or more feed ingredients. The desired protein level is put at the center of a collection of linked boxes in Fig.4.2.1 below:

4.2.1 SOME RULES TO KEEP IN MIND

In Pearson Square computing (see Fig 4.2.1), note that the subtractions are done DIAGONALLY between the target protein level in the center, and each of the ingredient’s protein values (see left half of Fig 4.2.1).

Also, the smaller value is always deducted from the larger one, hence NO negative values appear in the right half(Side B).



So, to arrive at the amount of each ingredient that needs to go into the ration to produce 25% Pr⁺, the following is done using the results obtained in side B.

$$\begin{aligned} \text{Required GNC content in the ration} &= 8/31 \times 100/1 = 800/31 = 25.8\% \\ \text{Required W.O content in the ration} &= 100 - 25.8\% = 74.2\% \end{aligned}$$



To be sure it is only GNC and W.O. mixed, one should be able to predict the fibre content of the ration
 Firstly the Fibre content of each of the ingredients have been determined to be:

W.O. = 9% known and GNC = 5% known

Therefore if the ration holds i.e. without any other ingredient apart from GNC and W.O.

W.O. = 9 x 3 = 27

GNC = 5 x 1 = 5
32

Divide 32 by the ratio sum = 3 + 1 = 4

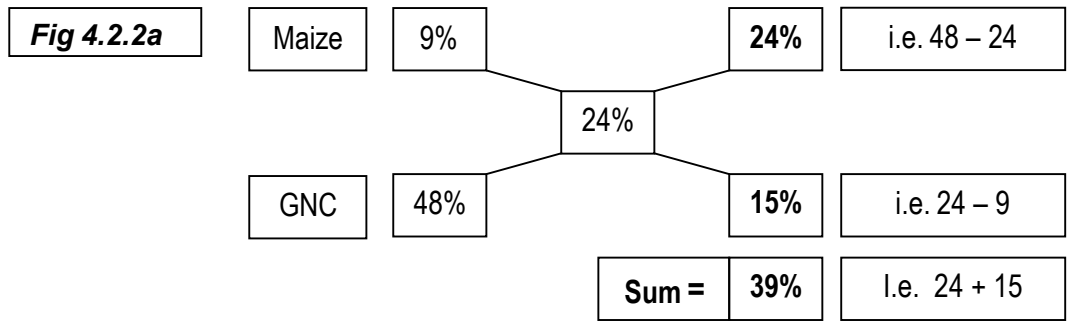
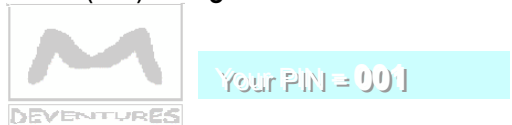
32 = 8
 4

If the fibre content of the mixture is close to 8(i.e. by analysis), then there would be greater assurance that it is only GNC and W.O. This is a simple way to crosscheck the integrity of feeds we suspect if the composition is provided by the supplier.

Example 4.2.2

Compounding a ration of 24% protein (Pr+) using:

a. Maize/GNC



The proportion of Maize required = $\frac{24}{39} \times \frac{100}{1} = 61.54\%$



The proportion of GNC required = 100 - 61.54 = 38.46%

i.e. in 1 ton of feed, maize content = 615.40 kg and GNC = 384.60 kg

$$\text{GNC} = \frac{15}{39} \times \frac{100}{1} = 38.46\%$$

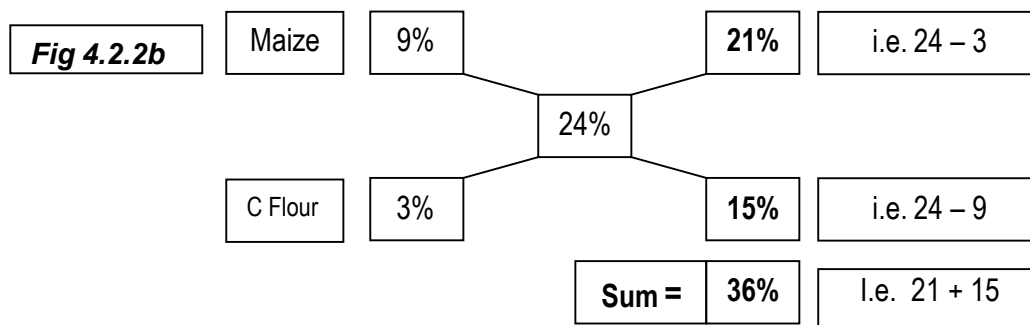
It is advisable to crosscheck that the derived requirements actually amount to 24% protein as follows:

For Maize : 9% CP x $\frac{61.54}{100}$ = 5.54

For GNC : 48 % CP x $\frac{38.46}{100}$ = $\frac{18.46}{24.00\%}$ Crude Protein

b. Maize/Cassava Flour (Note: Cassava Flour has 3% Pr⁺)

Let's attempt to use Maize/Cassava flour to compound a 24% Pr⁺ ration:



The proportion of Maize required = $\frac{21}{36} \times \frac{100}{1} = 58.33\%$

The proportion of Cassava flour required = 100 - 58.33 = 41.69%



i.e. in 1 ton of feed (i.e. 1000kg) Maize content = $\frac{58.33}{100} \times \frac{1000}{1} = 583.3\text{kg}$

Cassava Flour content = $\frac{41.69}{100} \times \frac{1000}{1} = 416.90\text{ kg}$

Again it is important that you check and confirm the desired Pr+ contents are still up to 24%.

CHECK

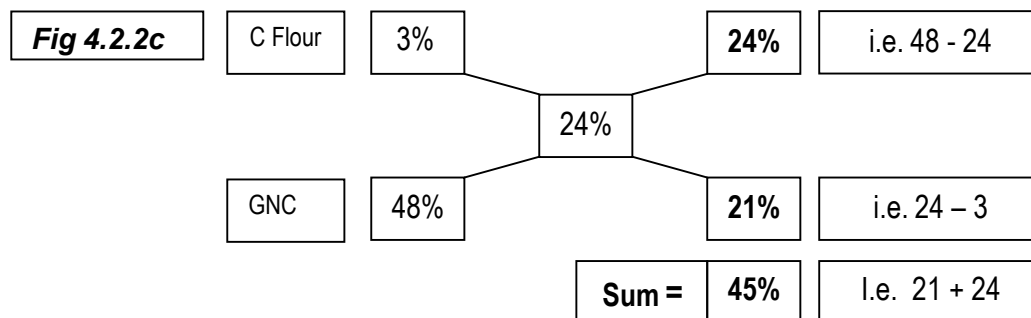
Maize = 58.33% = $9 \times \frac{58.33}{100} = 5.25\%$

Cassava flour = 41.69% = $3 \times \frac{41.69}{100} = \frac{1.25\%}{6.50\%}$ ~~X~~

Unfortunately, instead of having 24% Pr+ in the resultant poultry ration, what one will have is just 6.50%.

In other words, **two ingredients whose individual Pr+ contents are less than the desired protein level are never used**. It is therefore advisable to use one ingredient that is far higher in protein than the desired protein level, and use another that is lower in protein value, so one can complement the other. **Please NOTE the forgoing rule.**

c. Cassava flour/GNC





$$\text{Cassava flour content} = \frac{24}{45} \times 100 = 53.33\%$$

$$\text{GNC content} = 100 - 53.33 = 46.67\%$$

So, in one tonne of feed i.e. 1000kg, the cassava flour needed will be

$$\frac{53.33}{100} \times \frac{1000}{1} = 533.3\text{kg}$$

$$\text{and GNC content will be} = 466.7\text{kg}$$

CHECK:

$$\text{GNC} = 46.67\% = 48 \times \frac{46.67}{100} = 22.40\%$$

$$\text{Cassava flour} = 53.33\% = 3 \times \frac{53.33}{100} = \frac{1.60\%}{24.00\%}$$

The above means that GNC and Cassava can be used together for ration formulation: ***At least one of the sources of nutrients must have its protein level above the required level/content for the ration.***

4.2.2 TYPES OF FEED COMPONENTS

The ingredients so far used in the above examples are called **VARIABLE FEED COMPONENTS**. Examples include: Maize, Wheat offals, GNC, etc. They are called “variable” because they contribute protein. Others that do not contribute proteins (non-protein contributors) are called **FIXED FACTOR COMPONENTS**, because they do not contribute any protein. Examples include Oyster Shell, Bone Meal, Salt, and Vitamins/Mineral premix.



4.2.3 FEED ENERGY LEVEL

The energy level (Metabolisable Energy i.e. **ME**) supplied in the compounded feed is another important aspect of ration formulation that needs to be given careful consideration, if the desired results are to be achieved in the animals.

Different ingredients possess - and therefore contribute - different amounts of Metabolisable Energy (ME) to a ration. As such a need exists to ensure that the resultant formula has the required optimal level of ME. Table 4.2.3 gives a detailed breakdown of the composition of a poultry ration indicating the Metabolisable Energy contributions of each ingredient, and how they add up to that for the ration.

Table 4.2.3

Ingredients	% Contribution to ration	% Protein in Ingred.	% Protein in ration	Kcal ME/g of Ingred.	Kcal ME/g in ration
Maize	54.78	9	4.93	3.4	$(54.78/100) \times 3.4 = 1.86$
GNC	20.61	48	9.89	2.6	$(20.61/100) \times 26 = 0.54$
Fish Meal	5.15	65	3.35	2.5	0.13

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