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TECHNOLOGY OF FATTENING BROILERS INFERRED FROM CONDITIONS AND AVAILABLE SOURCES IN PERIURBAN AREAS OF MALI, WESTERN AFRICA

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SUMMARY

Broilers of two commercial strains were reared in outright made elevated floor pens. After the first 7-day period feeding commercial starter, two custom made mixture based on available components with 12,5% and 16% protein were fed. After the standard (6 week) fattening period, chickens gained 880 - 1680 g depending on the mixture type. More favourable feed to live weight ratio (FLR) was achieved with fish meal mixture (1,92 compared to 3,54 with bone-and- meat meal). Extending fattening period by 7 days resulted in higher weight gain but less favourable FLR (2,24). The possibility of keeping chicken alive 1 to 3 weeks beyond the 6-week period, to be able to follow possible fluctuation in market demand with no chance of frozen storage, was tested. In day 56 and 63 post hatch, the weight gain increased by 66-72% compared to 42 days but simultaneously FLR increased to 3,24 and 4,1. The influence of differences between optimal and actual temperature on feed consumption was analysed, and resulting optimised feeding schedule verified. The results as well as the design of fattening units and equipment made from local and in-house available sources are discussed.

Keywords: Broiler growing, technology, periurban farming, local sources

INTRODUCTION

In the last decade, population numbers in Africa grew up by 30% and although for the next decade a little lower growth rate (22%) is expected, the urban population numbers will increase from contemporary 35 to 48 %. Rapidly urbanizing low income countries are not sufficient in basic foodstuffs and urban/periurban agriculture is prevalent in all African cities as the only opportunity for family subsistence production. Anyway, food production attains not more than 2/3 energy and ½ protein amount compared to the world most developed countries and poultry growing may help out with this situation. Poultry meat production amounted in early 1960 about 1,3kg/head per year and varied largely across the whole continent, with the highest performance in the Mediterranean (over 2 kg) and the lowest in the central and southern Africa (below 0,5kg). Now 40 years after, especially during the last decennium we may see either manifold increase of production (5 to 20times) in some countries or almost the same score in others. Aside from ethnic, cultural, economic and natural constraints, these differences indicate considerable space for improving local productivity and affordability of food. Back-ups consist in modifying and introducing new progressive systems and technologies and poultry growers training. The poultry industry in tropics faces the challenges of climate and variable feed quality. The climatic constraints in the resources-rich countries are surpassed by managemental tools (automatic watering/feeding systems, cooling broiler houses (ventilation, evaporation, nutrition manipulation and phased feeding according to amino acid requirements). Unfortunately, one must do without them in most African countries. Other possibilities are however available (substitution of probiotics used in commercial feeds, for example with whey from processed goat/cow milk, promising by-products, residues and new plants to be incorporated into poultry feeding systems, exploitation of the ethnic medicine - this challenge is utmost emergent, as the use of antibiotics is probably not tenable for future).

MATERIAL AND METHODS

Environmental constraints

The most severe threat represent temperature and/or the compound effect of both temperature and relative humidity called temperature-humidity index (THI). In broiler chickens there is a critical threshold of 35oC and 75%RH, however the age-dependent optimum declines from 32 to 18oC through 1 to 42 days of life. Heat stressed birds consume less feeds and grow slowly, conditions for some diseases and mortality takes up (Teeter, 2000; Yahav, 1996; Gates, 1995 and Cahaner, 1995). Daily average of temperatures and the THI values during the test period compared to the optimum THI and the severe stress limit THI are on the figure 2.

Experimental design

Our project is focused on establishing the training farm oriented to poultry farming (or combined small ruminant/poultry farming) in urban/periurban production environment, to train family growers and to help build up the integrated production system. System of poultry farming consists of material flow among autonomous units alike following chart :

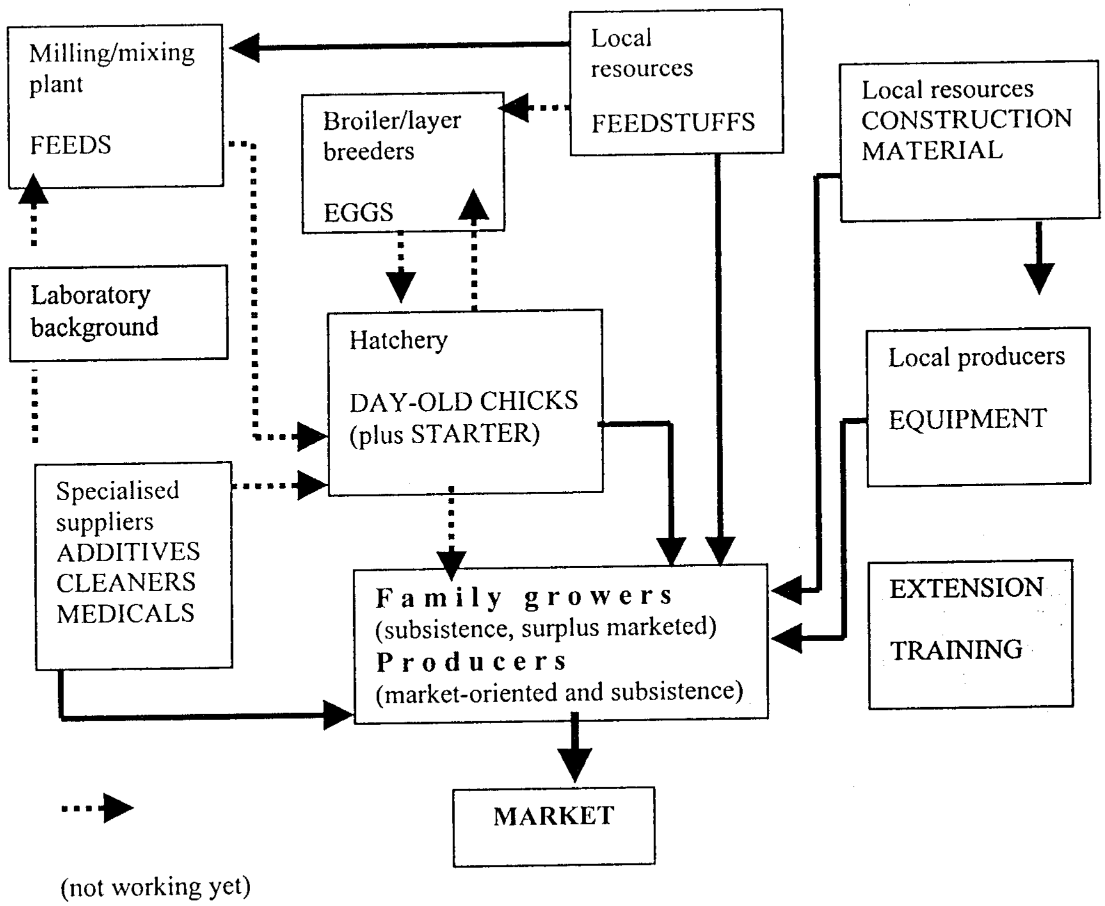

Fig.1 – System of periurban/urban poultry growing

As the hatchery is probably the most sophisticated element, other specialised and demanding activities of the system should be managed or provided there (mixing feeds, specialised supplies, marketing). Individual growers are free in choice to use these services. In Bamako city, there works the first Malian hatchery and array of suppliers, mixing feeds from local available components. However, composition varies widely within batches, as they usually have no chance to control it, as there are no funds available to acquire appropriate laboratory background. Introduction of designed system is capital assets demanding and as such not possible without looking after external supports and sources. First step therefore was pointed toward basic problems of broiler growers to find solutions from which they may benefit before the whole system is working to improve their current poultry plants. The results will also help them to design viable production projects to be submitted with credit or subsidy application.

Housing

The intensive growth requires intensive feeding and continual control, so that any extensive (scavenging) system could not be profitable. Chicken should be housed in pens, protecting them from predators (mice, snakes). Pens could be placed on backyards, flat roofs or any land not suitable for thee regular agricultural production After each crop, the pen must be completely cleaned out and disinfected. Successfully tested roofed pens (2,2 x 1,2 x 0,6 m) as the basic fattening units for 25 chickens have been made from local available material: wood, wooden ply, wire mesh. The pens are easy to move and clean even for women and elder children, who represent considerable labour power within urban farming systems. Elevated floors enable better air circulation and heat removal and easy handling.

Scrolled plastic sheets to protect from cold and wind during rains and overlapping roof with grass mats to avoid exposing birds to direct sunshine have been used. The roof will be painted with white colour in addition to reflect sunrays. Wooden shavings litter have been added as needed to keep birds dry.

Table 1. Operating mode for growing pens (number of birds along weeks)

Week	Pen 1	Pen 2	Pen 3	Pen 4
1	100	Sanitation	Sanitation	Sanitation
2	50	50	Sanitation	Sanitation
3-6	25	25	25	25
7	Sanitation	Sanitation	25	25
8	Sanitation	Sanitation	Sanitation	25
9	Sanitation	100	Sanitation	Sanitation
10	50	50	Sanitation	Sanitation
11-14	25	25	25	25
15	Sanitation	Sanitation	25	25
16	Sanitation	Sanitation	25	Sanitation

First 7-10 days (according to weather) birds are housed in one pen, in the second week divided into two pens and since 15-20 to 42 days into four pens, to create balanced groups. After six weeks half the crop (heaviest birds, about 1600g) are slaughtered. Remaining birds should be finished furthest to day 60. Sensitisation of the two empty pens must follow immediately, to be prepared for the next crop.

Minimizing the heat stress

Housing must protect chicken from rain and wind, especially during the first 10 days of life when the thermoregulatory system is not fully developed and the temperature must not fall below 28oC. Contrary to the end of fattening (6-8 weeks of life) the temperature should not exceed 24oC. Hence the stocking density for chicken since 6 weeks of age should not exceed 12 birds (18-20kg)/ m^2 to avoid overcrowding and heat stress (IMAEDA, 2000). Stocking density in tested pens reached max. 6,0 kg/m^2 - 14,5 kg/m^2 - 13,0kg/m^2 - 12,3 kg/m^2 during days 0-7, 8-14, 15-42, and 42-63 respectively.

Feeders and drinkers

Various types of feeders have been tested. The trough feeders are easy to fill up and clean, the trough with wire rack disallow chick to step in and waste the feed but thee cleaning is laborious. The trough length must be adjusted to bird's size, so that all chickens must have the possibility to eat all at once. Similarly there were various types of drinkers locally available. As in cities usually there are plastic bottles and cans redundant, drinkers made from plastic bottle was proven fine, easy to renew after each crop. The appropriate drinkers capacity is 5 litres/ 25-chickens to 4 weeks of age, after it the capacity should be doubled. By heat stress additional drinkers or plastic tubs were put at the litter to enable additional chicken cooling. Trough length available per bird has been 3, 6 and 12 cm during days 1-7, 8-14 and 14-63 and drinker capacity 5,10, and 20 liters/100 birds.

Feeding regime

Feeding schedule is temperature dependent. During the heat stress, feed has been distributed early morning and afternoon (7am, 5 and 7pm), to minimize additional metabolic heat produced from feeds 3-5 hours after consumption. Moreover, any movement increase heat production so that any excitation the birds during the heat is harmful. When the THI varies within stress limit (Fig 2), there were more feeding periods, about 3 to 5 times a day, so that broilers provided exercise and increased their feed consumption.

Feeds

At the brooding stage (day 1-12) chickens need high protein feed, at the growing stage (day13-42) they should be fed with finisher lower in protein. Therefore day-old chicks should be supplied with an amount of 240-250g starter feed directly by vendor at sale For the first 7 days chicken were fed with commercial started (21,6% protein) medicated with coccidiostat and during the next period two types of feed designed along to available components were tested. The local mash feeds were prepared in local milling/mixing plant in 14 days intervals and despite the same formula (Table 2), the nutrient content ex-post laboratory determined varied according to available component quality (Table 3). Amino acid - vitamin supplement dosed into drink water (6,25mg vitamin C into 1 l water) minimised microbial load because of changing the pH value Feeding practices using mixing basal diets with a portion of whole grain are introduced again, but there are of limited interest for chicks because of low exploitability of grain before 5th weeks of age.

Table 2. Composition of the local feed mash

Components	Higher protein (fish meal)	Lower protein (meat-bone meal)
Corn	50	50
Millet	15,5	15,5
Cotton -cake	13	13
Fish meal	13	-
Meat bone meal	-	13
Oyster shells and grit	8	8
Salt	0,5	0,5
Vitamins	0,002	0,002

Table 3. Feed components content (in %)

Feed	Dry matter	Fibre	Ash	Crude protein	Crude fat
Fish meal feed batch 1	87,9	3,46	10,9	16,0	4,15
Fish meal feed batch 2	89,4	3,98	14,6	16,5	4,84
Meat-bone meal feed batch 1	89,0	3,66	14,1	12,5	3,27
Meat-bone meal feed batch 2	91,2	3,32	14,8	14,6	3,05
Pure fish meal batch 1	94,5	2,2	39,5	30,6	6,60
Pure fish meal batch 2	91,9	2,9	25,0	48,4	9,36

On the beginning of the test, the last phase of the rainy season has been passing so that only limited amount of dried fish from the Niger river was available. Rather the sand with fish droppings from the place where fish are dried/smoked was disposed. After day 30 the situation has turned and increase of the protein content in feed resulted in immediate increase in the growth rate (fig 4).

Health program

Birds lacking any preventive treatment (vaccination) were used. During the first crop morbidity and mortality remained at zero level, in the next crop 3% of chicken were lost. In next crops carried in used pens higher losses should be presupposed. However, the key to any successful health program is prevention. The preventive cleanout program has been practiced:

- No contact with any other poultry has been allowed
- After each crop all equipment has been taken out, cleaned and disinfected
- All the litter has been removed into plastic bags for disposal and immediate area around pens cleaned
- Pens have been washed and spray disinfected
- Empty pens have been exposed to solar radiation for two weeks

Broiler strains

At present, male chickens in non-sexed layer flocks are slaughtered at the age of about 6-9 months for meat without any special fattening practices within common scavenging systems. Specialised thermo tolerant broiler strains have been developed in the last decade (Israel), yet the common commercial types (Cobb 500, Ross 308) have been used in our test to display all possible critical points of the designed system. Further research is needed to exploit gene pool of local breeds/strains for crossing.

Performance and carcass yield of broilers

After the 6 weeks fattening period, chickens gained 880 - 1680 g depending on the mixture type, broiler strain and sex. Males were heavier than females within both feed types and strains (tab.4), however the breast meat ratio was higher in females. Carcass yield achieved was higher in fish meal group. More favourable feed to live weight ratio (FLR) was achieved with fish meal mixture (1,92 compared to 3,54 with meat-bone meal). Extending fattening period to day 49 resulted by remaining birds in higher weight gain (1742g in Cobb/fish meal and 1576g Ross/fish meal group, 1393g in Cobb/meat-bone meal and 1340g in Ross/meat-bone meal) but less favourable FLR (2,24). The possibility of keeping chicken alive 1 to 3 weeks beyond the optimal 6-week period, to be able to follow possible fluctuation in market demand with no chance of frozen storage, was tested. In day 56/63 post hatch, the weight gain reached in remaining birds 1320 and 1287g as for Cobb and Ross respectively. Simultaneously FLR increased to 3,24 and 4,1.

Fig.2 Optimum and real average daily temperature and THI values during the te

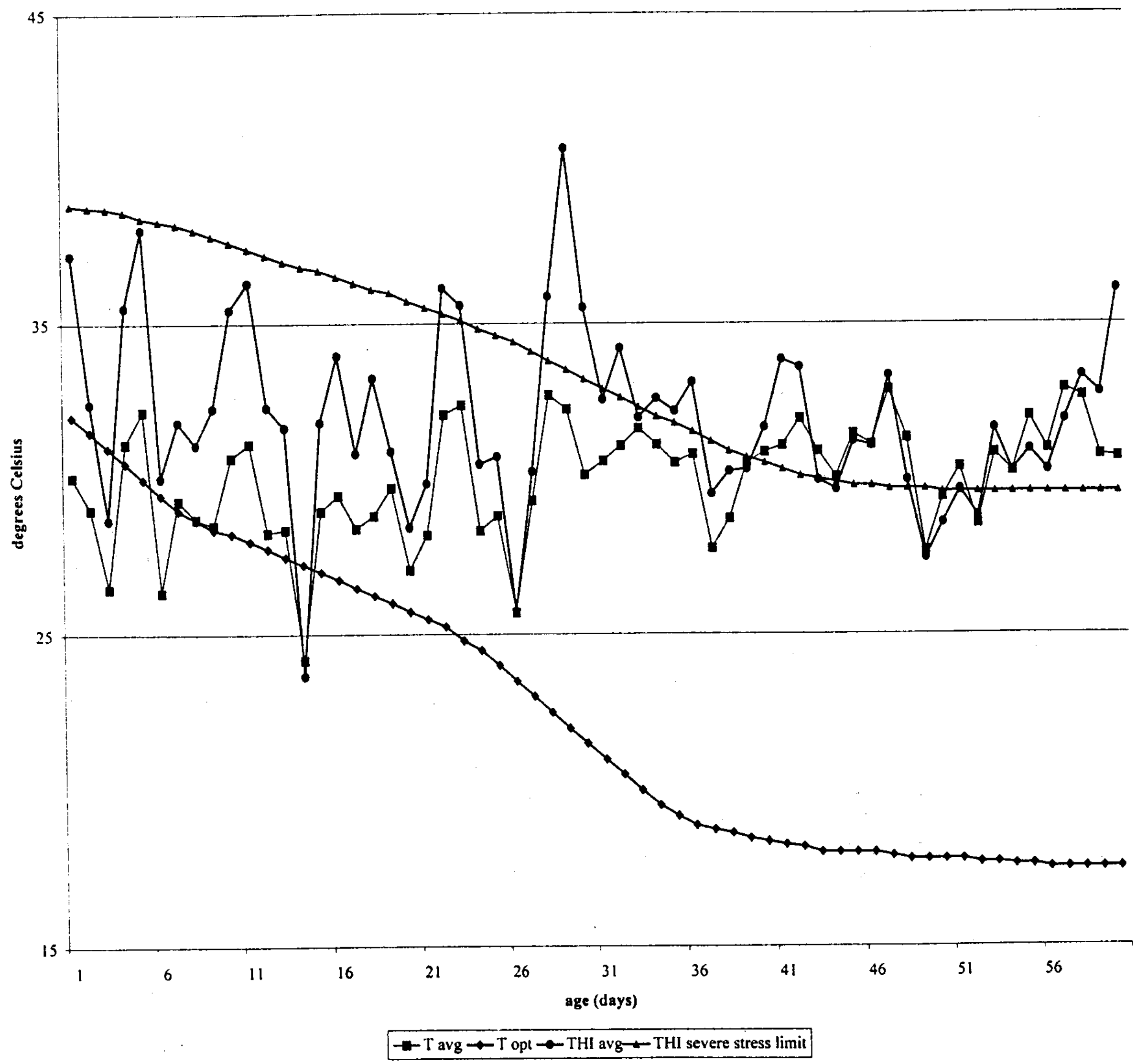

Table 4. Performance of broilers

Group	42 Live weight (g)	Carcass yield (%)	Breast meat (%)	49 Live weight (g)	Carcass yield (%)
Fish meal: Cobb males	1680	66,2	14,4	1742	68,7
Cobb females	1581	66,2	20,9	1620	
Ross males	1525	66,8	15,0	1576	67,4
Ross females	1418	67,7	19,8	1478	
Meat/bone meal: Cobb males	949	65,0	13,7	1393	68,9
Cobb females	692	Not slaughtered		1362	
Ross males	880	62,4	16,1	1340	67,1
Ross females	656	Not slaughtered		1290	

Expenses and gains

Investments and operational costs for 100 chickens/crop resulting from the test and estimate of savings to be expected could be used as a guide for similar production design.

Table 5. Expenses and gains resulted for the case of Bamako city, 1999

Items	Rate in CFA	Possible savings
Investments: growing pens	80 000	Up to 20% due to better exploitation
4-5 years service life, 15 crops (4)		of local sources
Feeders (8)	6 000	
Grass mats (4)	4 000	100% if self-made
Drinkers (4)	6 000	
Hand sprinkler	9 000	
Operational costs: Feed (300 kg)	44 000	Further research needed
Vitamin supplement (250g)	2 500	(new plants, by-products, ethno medicine)
Litter (80 kg)	1 000	
Cleaners / disinfectants	2 500	
Day-old chicks (100)	60 000	Support of the system needed to reduce price
Total investments /per crop	105 000/ 7 000	
Total operational costs	110 000	
Total costs per 1 crop	117 000	
Revenue: carcass 1600g/68% yield, 8% losses	170 000	
Balance	53 000	

CONCLUSION

Fattening of commercial line broilers tested under described conditions could be integrated into designed poultry growing system of urban/periurban farming. Further research is needed to confirm the attained performance within the long-term perspective, especially to evaluate this system under different season/climatic model and increasing infection burden following multiple broiler crops. Availability of this system and decision making steps (season and length of fattening, feed type, use of preventive vaccinations etc.) however will be dependent on local economic background.

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