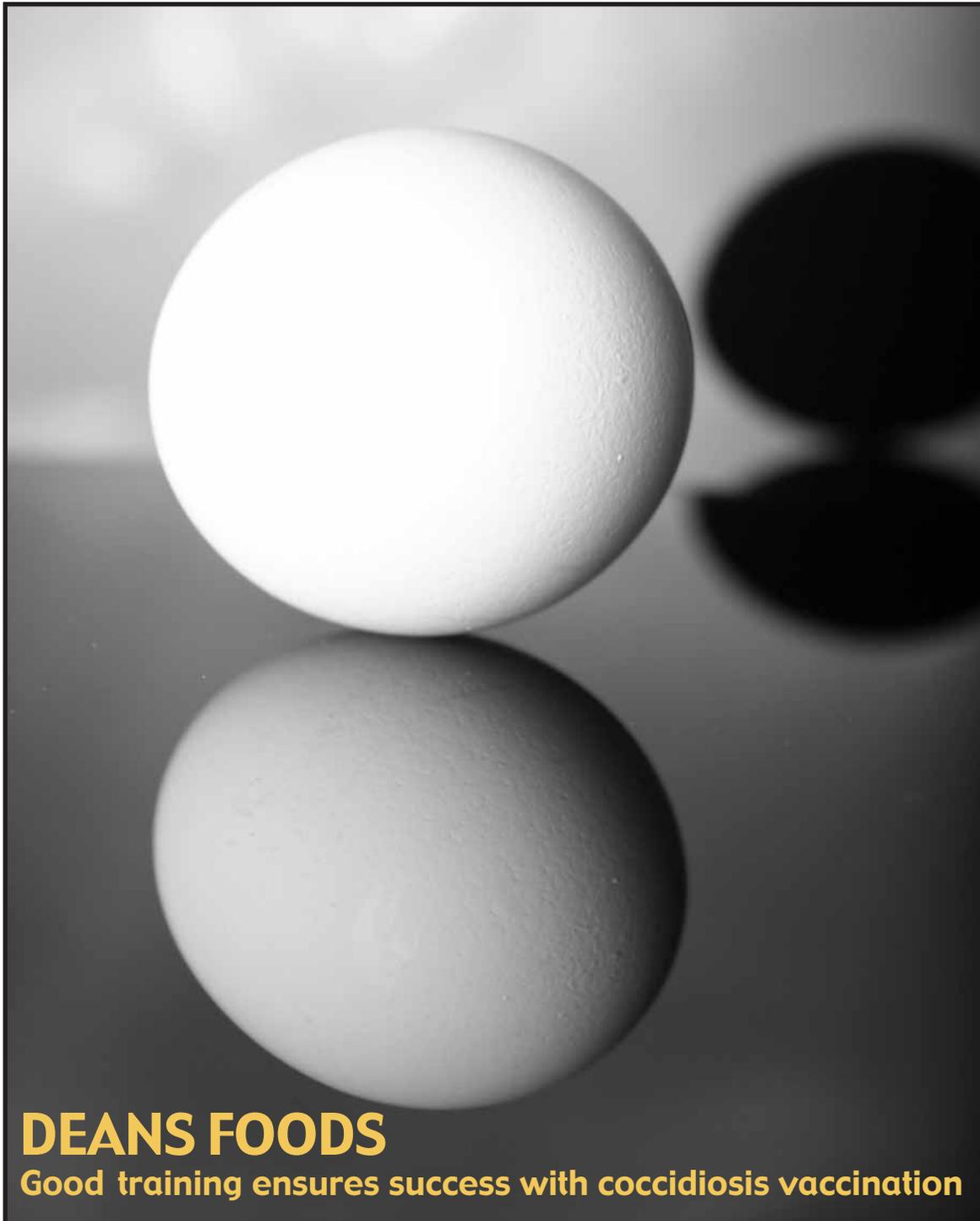

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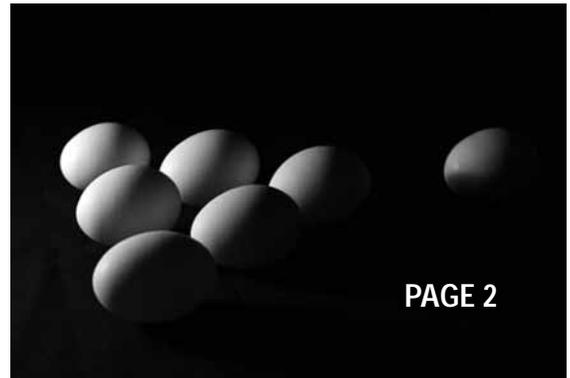
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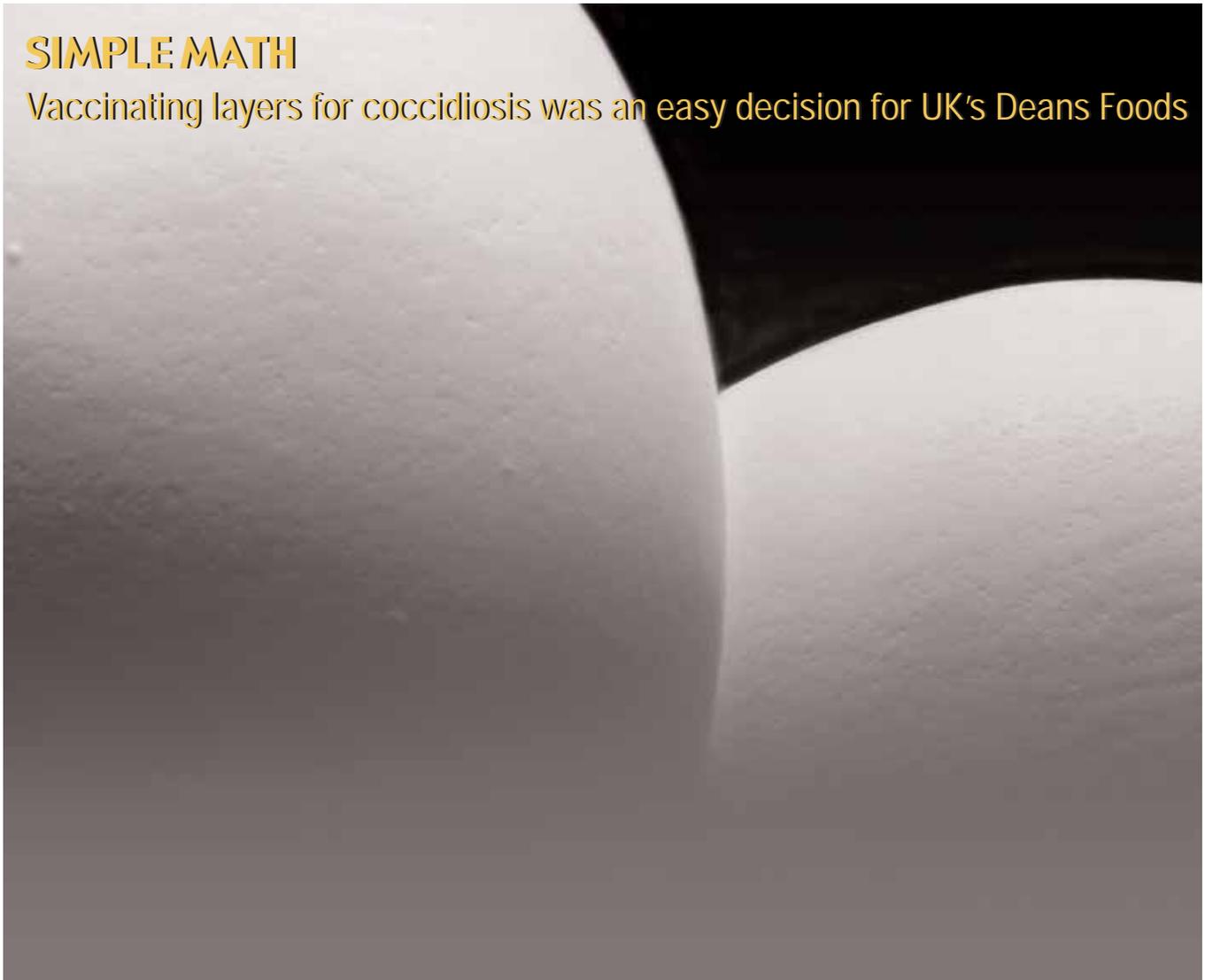
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Cover: One of nearly 4 billion eggs produced each year by Deans Foods in the UK. To learn more about their latest strategy for managing coccidiosis in layers, see page 2.

SIMPLE MATH

Vaccinating layers for coccidiosis was an easy decision for UK's Deans Foods



When you market nearly 4 billion eggs from 13 million hens every year, it's only natural to get preoccupied with numbers and analyze statistical trends.

The decision by Deans Foods — the largest egg marketer in the UK — to eliminate in-feed anticoccidials from its company-owned layer operations in favor of vaccination is one recent example.

In this case, however, management didn't need high-performance computers or elaborate spreadsheets to make their decision. It was a matter of simple math.

“Our decision to vaccinate was driven by two things,” explains Andrew Joret, operations director-agriculture for Deans Foods.

“One, we were seeing a growing number of birds with coccidiosis breaks, even though they had been treated with in-feed anticoccidials. That suggested resistance problems,” he explains.

“The second is that the number of in-feed drugs available to us is diminishing rapidly. We know it's a good practice to rotate anticoccidials, but between resistance and residue issues, there's not going to be anything left to

rotate in the future. It was clear that we needed to look at vaccination more closely.”

Getting it right

Vaccinating layers for coccidiosis with Paracox (also known as Paracox-8 in some markets) is not entirely new to Deans. The company tinkered with the practice in previous years but the results were sometimes inconsistent, an outcome they now realize was due to the error of their ways.

“A lot of the problems we had earlier resulted from us trying to cut corners a wee bit and save money by not using the full dose of the vaccine,” he says. “But closer scrutiny provided a solution, which is that Paracox at full strength is the only way to go.”

According to Dr. Charlie Broussard, director of global technical services for Schering-Plough Animal Health, the company that makes Paracox, using the correct dose is particularly important with coccidiosis vaccines because they provide a controlled and carefully balanced dose of oocysts, or eggs, of the *Eimeria* pathogens that cause coccidiosis. These in turn stimulate the bird’s immune system, providing lifelong protection against coccidiosis without resorting to resistance-prone drugs.

“If you use anything less than the full dose of the vaccine, you cannot achieve optimum uptake of the oocysts, nor can you expect there to be adequate protection,” he adds.

Good training essential

Good training is also critical to the vaccine’s success.

“With vaccines, whether it’s Paracox or anything else, it’s all about how they’re applied on the farm,” Joret insists. “If your farm managers aren’t properly trained, you can’t expect to have good results. Since committing to this program, we have not had any cocci problems to speak of. I think training has been the key.”

To make sure all farm managers were in sync with the new program, which involves administering the vaccine through the drinking water at 5 days, Joret sought assistance from local Schering-Plough representatives.

Besides dispatching technical personnel to the farms, Schering-Plough worked with Deans to produce *Eggstra*, an in-house publication that reviewed vaccine protocols and provided handy worksheets, checklists and reminders to help ensure successful vaccination.

Wanting to provide even more incentive for farm managers to learn proper and successful vaccination procedures, Deans and Schering-Plough also developed a contest to see which operations could administer the vaccine most effectively.

According to Schering-Plough poultry business manager Iain Brown, this involved getting managers to collect 10 individual fecal droppings from each shed so a laboratory could determine the level of vaccine uptake by the flock.

Counting oocysts

Why fecal testing?

“We know that the laboratory-produced vaccine strains have a shorter life cycle inside the bird than the wild strains that occur in the field,” says Dr. Sarah Rennie, technical business manager at Schering-Plough.

“By testing 5 days after vaccination, any oocysts found in the sample are more likely to have come from the vaccine than any wild strain, which can take 6 to 7 days to appear in the feces.”

One thing fecal tests don’t show is



the immune status of the bird. Vaccinated birds do not become immune to coccidiosis until 2 weeks after vaccination, but the effect lasts a lifetime.

“But if the vaccine has taken hold, immunity is likely to follow unless some other factor on the farm prevents vaccinated birds from developing immunity. For example, stress, immunosuppressive diseases or poor quality nutrients in the feed can all have an effect on the development of the immune response in vaccinated birds,” she says.

Knowing the score

Oocyst counts from the samples are rated on a scale of 1 to 5, with 5 being the highest. She explains that the aim of the program is to have no birds test negative for vac-

cinial oocysts and to have the birds score from 1 to 3 (1 to 1,000 oocysts per sample).

“It is theoretically possible to score 4 or 5 (1,001 to 10,001 oocysts), but this would be exceptional and would probably indicate the presence of wild strain oocysts,” she says.

For example:

- Farm A reports that 7 of 10 samples were negative and the other three scored 1 (1 to 10 oocysts). This indicates very poor vaccination.
- Farm B reports that all birds tested positive, but the oocyst count score was low. This suggests “reasonable vaccination,” according to Rennie.
- Farm C has all birds testing positive with scores from 1 to 3 (1 to 1,000 oocysts), which suggests the birds are uniformly immune to coccidiosis.

Joret says the contest, which awards prizes to managers with the best scores,



Joret: ‘The program has been very successful.’

More on the floor

Deans Foods has only one company-owned farm with cage-reared layer pullets. All other birds are reared on floors, a setup that puts the company in good position to meet new EC regulations, which prohibited the installation of any conventional wire layer cages after Jan. 1, 2003, and eliminates them in 2012.

Floor-reared birds are generally more susceptible to coccidiosis, which is routinely spread when infected birds shed oocysts, or eggs, of *Eimeria* pathogens in their droppings, which contaminate feed, dust, water, litter and soil. Even so, Deans’ Joret says coccidiosis is still an issue in caged birds and all flocks need to be protected.

“The market is definitely moving toward free-range birds, so we’re lucky in that respect because most of our rearing was on the floor anyway,” he adds. “We’re well aware of the threat that coccidiosis presents in these situations.”

Research by Mintel, a UK-based market research firm, confirms this trend.

According to a 2003 report, free-range eggs accounted for 30% of egg sales by volume in the UK compared to just 24% in 1998, representing a 38% rise in sales.

Producers also need to be extra careful about drug residues. In January 2004, EU legislation was put in place requiring that every egg be stamped with a home address, producer code, country of origin and “best before” date.

While beneficial to consumers, this has proved challenging for egg producers. Fortunately, Joret says, the use of coccidiosis vaccination and better nutrition has allowed Deans to sharply decrease usage of in-feed medicinal additives without compromising performance.

is repeated periodically to “provide a refresher” and ensure diligence in the field.

“The competition serves as a reminder for everyone involved in rearing to get it right consistently, whether rearing for our company laying farms or for external pullet sales,” Joret says. “The program has been very successful.”

‘Proved to be effective’

John Simpson, area production manager for Deans’ North Region, which encompasses 20 farms in Scotland and the north of England, has also been pleased with the results of the coccidiosis vaccination program.

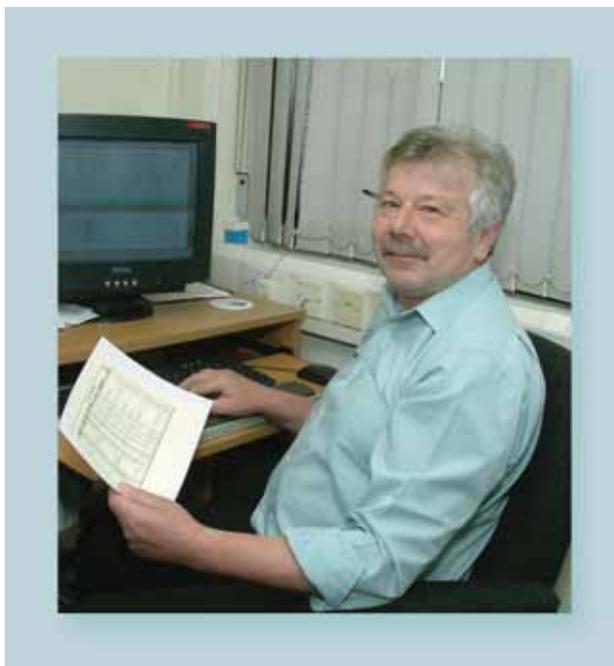
“We haven’t had a problem with coccidiosis, and we’ve never had to use a disinfectant on any of the floors,” he says. “I was apprehensive at first, but then it’s human nature to be apprehensive about change, isn’t it? For us, vaccination has proved to be effective and very simple to use.”

He notes that in the past birds on in-feed anticoccidials sometimes broke with the disease after 6 weeks, which required Deans to use additional antibiotics, which added to the overall cost of the treatment.

Furthermore, the in-feed treatment had to be pulled from the feed at 12 weeks to avoid residue concerns. “That left the birds without any coccidiosis protection from 12 weeks until they started laying eggs at 18 weeks,” Simpson says. “The vaccine provides much longer protection, and you don’t have to worry about resistance or residues.”

To help make up for the loss of any growth promotion effects of in-feed anticoccidials, Deans has also been placing more emphasis on promoting good intestinal health through better nutrition. According to Joret, this involved making a few changes to the layer pullets’ feed rations.

“We didn’t change the diets themselves,” he says. “We only changed the schedules at which they were fed.



Simpson: ‘Effective and very simple to use.’

Without having drugs in the feed, we could be a lot more flexible and focus more on the nutritional needs of the birds.”

For example, Deans used to pull birds off the starter feed at 3 weeks and off the rearing feed at 6. Now, the company keeps layer pullets on the starter feed for 4 weeks and extends the rearing feed to 8.

“And that seems to have done the trick,” he says.

You can’t keep a good oocyst down

Coccidiosis, a ubiquitous protozoan disease common in standard broilers and other floor-raised birds, is routinely spread when infected birds shed oocysts of *Eimeria* pathogens in their droppings, which contaminate feed, dust, water, litter and soil.

Fresh oocysts are not infective until they sporulate, usually in 1 to 2 days under optimal conditions — 21°-32°C (70°-90°F) with adequate moisture and oxygen. Oocysts are resistant to most disinfectants commonly used around livestock.

They have also shown resistance to in-feed anticoccidials when those medications are used for extended periods.



THINNING FLOCKS TO FATTEN PROFITS

Vaccination for coccidiosis complements thinning, increases flexibility for producers

It's easy to see why thinning broiler flocks has become a popular practice throughout Europe. Thinning lets poultry farmers satisfy market demand for light or heavier birds and, at the same time, capitalize on the economies of scale and enjoy increased profits.

But when traditional in-feed drugs are used to control coccidiosis, thinning has a down side. The required withdrawal times for anticoccidials hinder market flexibility and complicate feed management. With anticoccidials, there is always concern that residues of the drugs could end up in poultry meat at a time when public demand for food safety is at an all-time high.

Farmers can, however, optimize the benefits of thinning and eliminate the problems inherent to anticoccidial use by vaccinating against coccidiosis at day-of-age.

"Vaccination fine tunes the practice

of thinning," says Dr. Paolo Sani, a veterinarian and poultry business manager for Schering-Plough Animal Health in Italy.

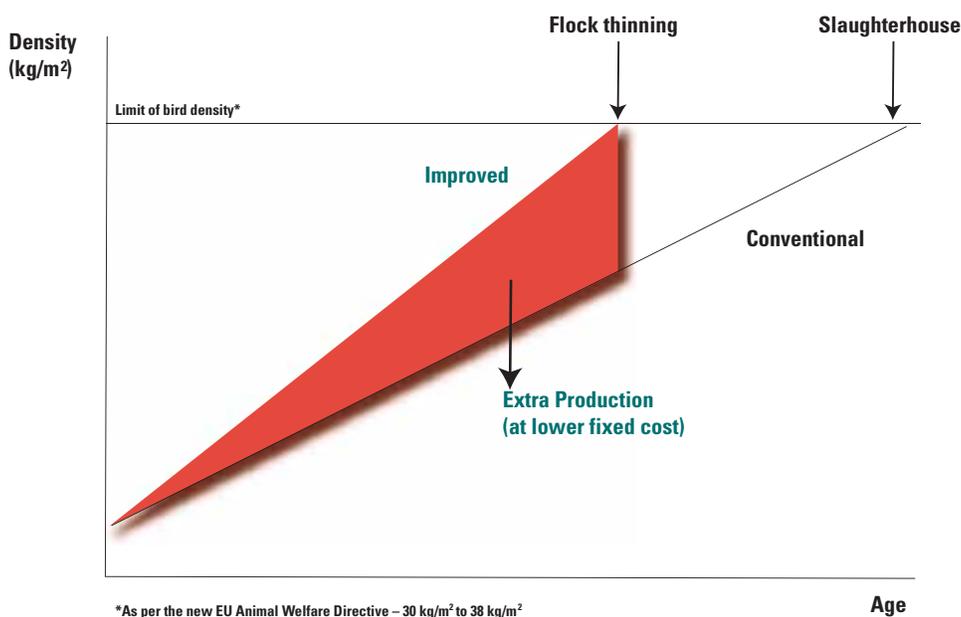
"It not only provides lifelong protection against coccidiosis, it increases market flexibility, dramatically simplifies feed management and completely eliminates worries about anticoccidial residues.

"In fact, we are finding that coccidiosis vaccination has evolved from a disease-control method into a management tool that enhances the practice of thinning," he says.

How thinning works

When flocks are thinned, Sani explains, lighter, less efficient females are sold. The weight at which females are thinned out varies among companies and with market needs. Some companies may start female thinning at about days 35 to 37 (Figure 1), when the birds are 1.7 kg (3.75 lbs). Occasionally,

Figure 1. Flock-thinning concept, typical scheme



there is a thinning of heavy females or light males about days 44 to 46, when birds are 2.4 to 2.6 kg (5.29 to 5.73 lbs). After each thinning, space is freed up for a greater number of faster-growing, large-breasted males that are sold later in the production cycle for chicken parts and high-volume commercial sales, Sani says.

Thinning can be practiced within the limits of European Union welfare laws, which dictate a maximum of 30 kg (66.14 lbs) meat production per square meter in buildings with natural ventilation systems and 38 kg (83.78 lbs) of meat produced per square meter in buildings with artificial ventilation systems, he notes.

Generally, the same house is used for all birds in flocks to be thinned, but males and females are divided by removable fences. After the first thinning, the remaining birds occupy the full space, he says. Additional thinnings can be made based on market demand, in contrast to “mono” systems that start all birds at the same time and send them to market at the same time.

Thinning provides farmers with the

best balance of light and heavy birds. It significantly improves space utilization and the kilos of meat produced per square meter, reduces fixed costs and improves performance among heavy birds, Sani says.

“Farmers have increased income and better return per kg of meat, while the integrator optimizes the logistics of broiler production,” he notes.

Cost savings

For instance, since thinning enables more birds to be raised in the same house, the costs for transporting feed and chicks to the house as well as chicks to market declines, he says.

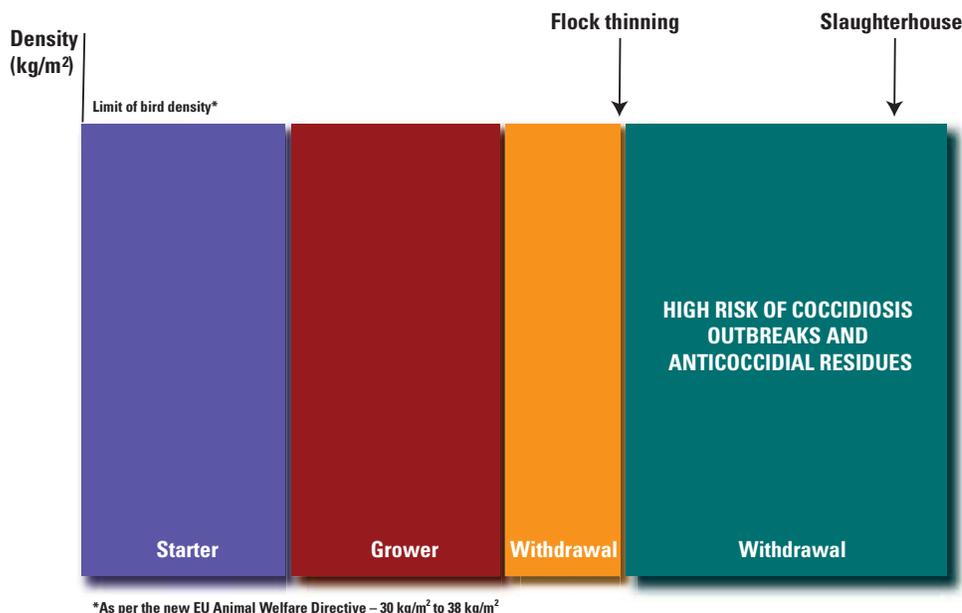
Economic analysis demonstrates that transport of feed alone, determined by examining the results among several producers in Italy, can be reduced from 10% to 20% by thinning, although the savings would vary by country and among different producers. The estimated cost reductions



Sani: ‘Fine tunes the practice of thinning.’

continued on page 8

Figure 2. Flock thinning, feed management with in-feed anticoccidials



among several Italian producers for transporting chicks to farms and to the slaughterhouse ranged from 20% to 30%, Sani says.

Dr. Luciano Gobbi, technical service manager for Schering-Plough Animal Health, Italy, says there's another added benefit from thinning. "It becomes easier to raise heavier birds in the heat of summer."

As the chicks age, heat can be detrimental to their health, but thinning gives heavier birds more space and they can remain cooler, he says.

Thinning, however, definitely complicates coccidiosis control when traditional in-feed anticoccidials are used, Dr. Gobbi agrees.

"Anticoccidials require at least a 5-day withdrawal time (see Figure 2), so birds marketed early have to receive a withdrawal feed

before they are sent to slaughter. Great care must be taken to assure that the right birds within a flock get the correct feed," he says.

When anticoccidials are removed to adhere with withdrawal requirements, birds intended for early marketing are at risk for a costly coccidiosis outbreak, he says.

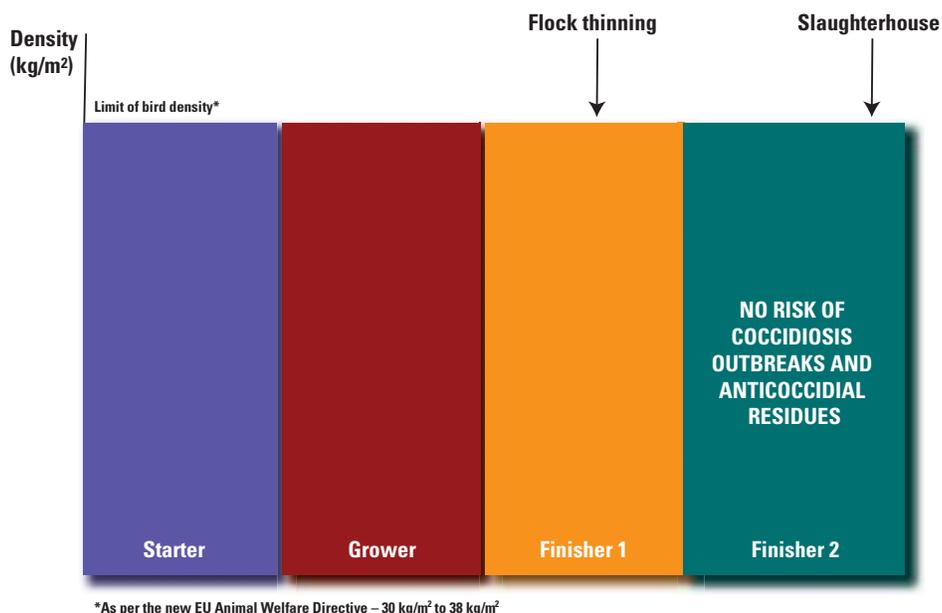
"The overriding concern about the use of in-feed anticoccidials, however, is that residues of the drugs will unintentionally end up in poultry meat, which could be immensely damaging to a poultry producer in light of the public focus on food safety. All it takes is an error at the feed mill or a farmhand giving the wrong feed to the wrong group of birds within a flock," Gobbi says.

All the potential complications associated with anticoccidial use can be eliminated simply by vaccinating birds against coccidiosis once at 1 day of age, Gobbi says. In return, farmers who thin their flocks will find that management of feed and of the birds will be dramatically simplified, he says.



Gobbi: 'Vaccination is a real problem solver.'

Figure 3. Flock thinning, feed management with Paracox-5



Case in point

As a case in point, Gobbi points to Martini Alimentare, one of Italy’s major poultry companies, which has coupled Paracox-5 vaccination against coccidiosis with the practice of thinning (*CocciForum*, No. 10). Males and females are kept in the same house but in separate areas. Females are usually thinned out at days 35 and 42, some males are thinned out at 46 days and the remaining males are slaughtered at 54 to 56 days.

Dr. Corrado Longoni, poultry veterinarian for Martini, says, “If we used an anticoccidial in the feed, it would mean having two or three withdrawal periods, which would be very difficult to manage.”

Feed mill contamination would also be a very real concern for Longoni if the company used in-feed anticoccidials. The feed mill does not make feed just for broilers, he says, and the lines at the mill would have to be flushed after every use to insure that anti-

coccidial residues did not get into feed for non-target species.

“We can’t take that risk, nor do we want traces of drugs in our withdrawal feed for broilers,” Longoni says.

“Martini as well as other companies that practice thinning,” says Gobbi, “are discovering that vaccination is a real problem solver and that it provides excellent control against coccidiosis. When coupled with good nutrition, the performance among vaccinated birds at the very least meets performance among birds raised with in-feed anticoccidials.”

Vaccination also yields indirect savings for poultry farmers by reducing the labor it takes to manage the feed and the birds in thinned flocks. “It’s an excellent complement to the practice of thinning,” he says.



Longoni: ‘We can’t take that risk.’

BUILDING ON A GOOD IDEA

Fine-tuning wheat-based rations together with coccidiosis vaccination gives producers in Northern Europe more flexibility

Progressive poultry operations have discovered that putting more emphasis on intestinal health can help broiler chicks combat enteric challenges and reduce or eliminate the need for in-feed antibiotics.

In most cases, improving intestinal health usually means pouring more resources into the starter and grower diets to build immunity and optimize digestibility. The payoff comes at the back end of the feed program, when broiler operations can either start birds on low-cost final feed at an earlier age or possibly introduce a second final feed without compromising performance and returns.



Rennie and ten Doeschate: 'Pretty unique challenges.'

This four-pronged strategy — frequently called the IDEA concept for Impulse, Digestibility, Economy and Advance (see accompanying story) — makes good sense for almost any operation trying to wean itself from antibiotic growth promoters, which helped keep some enteric problems in check.

The IDEA concept has proved to be particularly beneficial where a vaccine is used instead of an in-feed coccidiostat to control coccidiosis because producers don't have to work around the coccidiostats in the feed.

“In traditional anticoccidial programs, you have to build your nutrition program around the rotation schedules and withdrawal times,” explains Dr. John Radu, a veterinarian and worldwide technical service manager for Schering-Plough Animal Health.

“When you vaccinate for coccidiosis, you don't have those restrictions. You can tailor the nutrition program to meet the needs of the birds at a specific age, not the timetable for the coccidiostat program. The result is often a better nourished and healthier flock, one that might get by on lower cost rations in the final phases.”

Comparing nutritional requirements

Dr. Rob ten Doeschate, a poultry nutritionist at Abnatech Global, Peterborough, England, believes the nutritional requirements of vaccinated and medicated birds shouldn't have to be any different. They're the same birds with the same nutritional requirements, he argues. They also have similar challenges from coccidiosis.

“Because at the end of the day, both types of birds should have a minimal coccidiosis challenge,” he says. “We do know that a vaccinated bird at certain stages has to cope with a bit of a controlled challenge caused by the oocysts in the vaccine. But at the same time, birds on a standard in-feed anticoccidial program are often faced with a similar and perhaps less predictable challenge because the coccidiostats don't provide 100% control. Lesion

scoring tends to be about the same for both groups.”

He notes that field strains of *Eimeria* organisms that cause coccidiosis are developing resistance to in-feed anticoccidials. “And we’re seeing a lot more of that in recent years because there are even fewer in-feed products available to rotate,” he says. “When every poultry company is on the same rotation, there’s nothing to compare it to and no one knows if one company’s program is doing better than the other. The reality is that this background challenge could be quite high even in birds on coccidiostats and we just don’t realize it.”

Ten Doeschate agrees with the principles of IDEA. However, in Northern Europe and other areas with cooler, damper environments, he thinks producers might actually have an easier time embracing the IDEA concept — for the simple reason that they’ve had to practice it all along.

“We have some pretty unique challenges in the UK,” he says. “We’re raising birds in less than ideal economic conditions, where investment is difficult, land prices are high and building is expensive.

“Then you have the issue of our weather, which is legendary,” he continues. “It’s generally much cooler here than in southern Europe. And as everyone knows, we get a lot of rain. That creates more problems maintaining the litter, which can become a fertile breeding ground for coccidial oocysts.”

Working around wheat

Feedstuffs also present a challenge. Like their counterparts in other areas of Northern Europe, producers in the UK feed 100% wheat-based diets. Besides being coarser in texture and rougher on the intestinal wall than diets incorporating maize, the resulting digesta also have high viscosity, which favors the growth of the undesirable bacteria that cause enteritis.

“We use enzymes to combat that, but even with enzymes we have higher viscosity than you would have with maize-based diets,” he explains.

The absence of antibiotic growth promoters, which in the past had some effect on enteric disease and helped to make up for any shortcomings in management, presents another chal-



lenge to producers. While many poultry operations in the EU are still adapting to the January 1 ban on such products, ten Doeschate says UK producers have pretty much done without them since 1998, when all the major UK supermarket chains instituted a ban of their own.

Overcoming adversity

His point is that UK poultry producers

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Adapting IDEA to Northern Europe

Schering-Plough Animal Health devised the IDEA concept to help birds vaccinated against coccidiosis achieve their performance potential.

For the UK and other northern markets, however, the IDEA concept needs some refining because some aspects of the concept are already routine practice in this market.

“The majority of the market is already using very high specification starter diets, at or above breed standards,” notes Dr. Sarah Rennie, technical business manager for Schering-Plough Animal Health in the UK.

Working with Dr. Rob ten Doeschate at Abnatech Global, Rennie set up a trial to investigate the Digestibility and Economy phases of the IDEA concept.

Good gut integrity

“During the grower period, maintaining good gut integrity and efficient digestion is not easy to achieve, especially in the absence of antibiotic growth promoters and in-feed anticoccidials,” she explains.

“We wanted to investigate whether adding betaine and adjusting the amino acid profile during the grower phase would have an impact on performance. We also wanted to see if not changing the diet during the critical 13- to 27-day period helps maintain gut integrity.”

According to the IDEA concept, vaccinated birds should be able to utilize lower cost final diets better than medicated birds, which was the last factor to be investigated in this trial.

In their 64-pen trial, they had 25 male and 25 female Ross 308 broilers per pen. Basal diets were formulated to current UK nutritional standards. Trial diets were supplemented with up to 10% whole wheat, reflecting current on-farm practice in the UK.

Coccidiosis was controlled by either vaccinating day-old chicks with Paracox-5 or with a combination of in-feed anticoccidials — nicarbazin and narasin from 1 to 12 days, and monensin in the grower (13 to 27 days) and finisher (28 to 35 days).

They wanted to determine whether the following would impact performance:

- **Adding nutrients** thought to be beneficial to gut health — methionine, threonine and betaine — to the starter, grower and finisher rations.
- **Avoiding a feed change** during the peak vaccinal oocyst multiplication (around day 20). Birds were fed grower diet A from 13 to 20 days followed by grower diet B (reduced nutrient level) from 21 to 27 days. Other birds received grower diet B from 13 to 27 days.
- **Using a lower-spec final feed** (-5% digestible amino acids) from 36 to 42 days without reducing bird performance.

At 42 days, they found no statistically significant ($P>0.05$) interactions between methods of coccidiosis control and feed treatments, nor were there any significant differences in live weight or feed conversion in any of the birds.

Cutting costs possible

The results suggest that in Northern Europe, there is no performance benefit from enhancing the starter diets or cutting the number of grower diets from two to one in vaccinated birds. Furthermore, using a lower spec final feed in vaccinated birds did not affect liveweight or feed conversion.

“This indicates that cutting costs at this phase may be possible,” Rennie adds.

They concluded that using Paracox-5 in broilers fed good quality basal rations is not associated with a drop in performance and dietary enhancement is not needed.

Further work is needed to determine how much producers can take advantage of the vaccinated birds’ improved status, which in this case allowed a reduction in concentration of certain essential amino acids in the final feed without hurting performance.

The full scope of the study and additional insights on the results will be presented at the European Poultry Conference in Verona, Italy, September 10-14.



are used to facing all sorts of economic, environmental and political adversity. As a result, they've had to become highly resourceful and more cognizant of maintaining good intestinal health to fight disease and enhance performance, he says.

The principles of IDEA are already in place. With more operations turning to coccidiosis vaccination and pulling anticoccidials from their feed, ten Doeschate is hoping to take advantage of this newfound flexibility and make further refinements to their programs.

"When I first saw the IDEA concept, it wasn't really new to me because we were already following most of its principles," he says. "My challenge is optimizing feed conversion, health and ultimately on the amount of money the grower makes."

"We don't mind spending a bit of money on the starter diet because you only feed a small amount to the birds,"

he continues. "The grower is quite happy to pay £5 a tonne more (over a £160 per tonne average) if he can see a penny a bird more profit. We're already in the habit of getting birds off to a good start. If you're already using a high-spec starter diet, you can't really improve much on it."

He notes that in some parts of Europe, producers have used sodium to boost feed intake in the starter. "But that's not an option here because sodium also encourages birds to drink more water," he says. "And when they drink more water, you get more water coming out the other end — and that creates problems for litter quality and bird welfare."

Making good rations better

Ten Doeschate initially targeted the Digestibility phase of the IDEA concept — approximately 13 to 27 days — to see if further improvements could be

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What's the big IDEA?

By adapting nutrition programs to the physiological situation in the intestine of vaccinated birds and matching nutrient needs to the building of immunity in each period, vaccinated birds will perform better. This is spelled out in the IDEA concept:

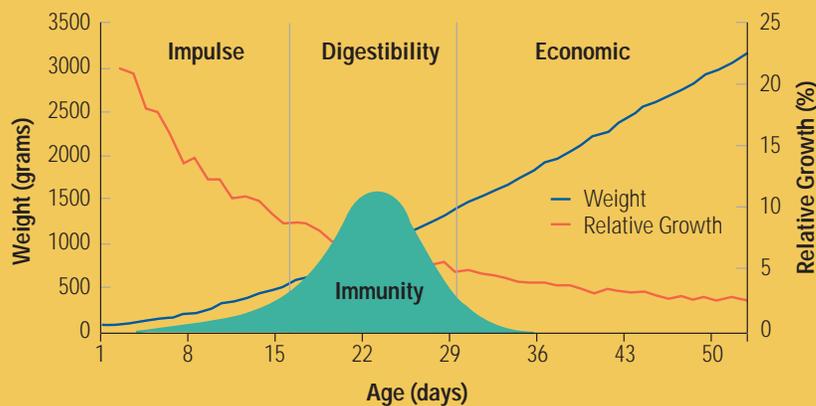
I: Impulse phase. Prepare the immune system and intestinal cells for the development of immunity against coccidiosis; at the same time, get the birds off to a good start.

D: Digestibility phase. Help the immune system and intestinal cells build immunity. This is important not only for coccidiosis, but also because most intestinal infectious problems and disturbances occur in this period.

E: Economy phase. Take advantage of birds' immunity against coccidiosis with good intestinal health.

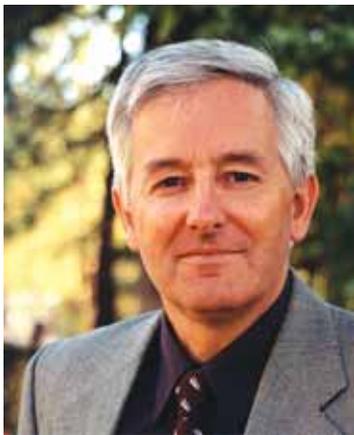
A: IDEA enables an Advance in poultry farming and is a good alternative for the new era when in-feed additives will no longer be available.

Growth curve, relative growth and *Eimeria* cycling, and immunity development



ESSENTIAL ELEMENTS

Independent project group develops guidelines for coccidiosis vaccines



By H.D. Chapman, Ph.D.
Department of Poultry Science,
University of Arkansas, USA

Increased recognition that live vaccines provide a valuable alternative to chemotherapy for coccidiosis control has encouraged researchers around the world to consider development of coccidiosis vaccines for local use. As with all products developed for the poultry industry, it is essential that vaccine development be carried out using rigorous procedures and high professional standards that also comply with any official regulations that may be applicable.

Guidelines have long been available to help researchers satisfy standards for drugs and many viral and bacterial vaccines — but none have been produced for vaccines against coccidiosis. Consequently, the author recently assembled a group of experts to participate in a joint project aimed at finding a remedy to this deficiency. The team included myself and the following esteemed experts:

- **Professor Martin Shirley**, deputy director of the Institute for Animal Health, United Kingdom, lead the

research team in the 1980s that developed the world's first attenuated coccidiosis vaccine. More recently, he was instrumental in organizing a successful project to sequence the entire genome of *E. tenella*, the most widespread, pathogenic species of *Eimeria* that infects the chicken.

- **Dr. Ray Williams**, of the UK, is one of the world's leading coccidiosis researchers with vast experience in the poultry industry. Dr. Williams has published numerous papers about avian coccidiosis and vaccination.

- **Dr. Brian Roberts**, also of the UK, is an international authority with detailed knowledge of the registration requirements necessary for obtaining marketing authorization for poultry vaccines.

The project group's goal was to develop guidelines to assist scientists and others in the design, implementation and interpretation of studies for assessing the efficacy and safety of live coccidiosis vaccines and to suggest standards for manufacture and quality control. The resulting guidelines are intended to help researchers obtain specific information for those involved in the decision making process and to facilitate the worldwide adoption of consistent, standard procedures.

The team received advice from veterinarians, researchers and those with practical knowledge of poultry production. Scientists working in government, academia and industry around the world were consulted, but the sometimes controversial opinions expressed in the guidelines are the group's own. A leading poultry veterinary journal, *Avian Pathology*, published the guidelines¹, which are shown below.

KEY POINTS

- Rigorous procedures and high professional standards are necessary to ensure safe and effective poultry products.
- Standards for evaluating coccidiosis vaccines have been lacking.
- To remedy the deficiency, several top coccidiosis experts recently developed guidelines to facilitate the worldwide adoption of consistent standards for evaluating the efficacy, safety, manufacture and quality control of coccidiosis vaccines for poultry.

Procedures

Birds in vaccine development studies should be vaccinated under conditions that duplicate as closely as possible the manner in which vaccination will be carried out in the field. Subsequently, birds should be intentionally challenged with the parasite to see whether they have acquired protective immunity.

An important aspect of experimental design is that vaccinated birds must be reared in floor-pens to allow adequate exposure to infection following vaccination; the challenge phase of experiments can be carried out in wire-floored cages or pens. The guidelines as published in *Avian Pathology* provide detailed information about conducting these studies.

Once satisfactory results have been obtained from experimental studies, large-scale field tests can then be carried out; this is important to establish that a vaccine is safe for use in the field. Preferably, such trials should be carried out in all geographical regions where a vaccine is intended for use.

Criteria for efficacy

The criteria conventionally used to evaluate drug efficacy, such as weight gain, mortality, feed conversion and the presence of intestinal lesions, may similarly be used to determine the extent of immunity development following vaccination and subsequent challenge. However, in the opinion of the project group, lesion scores are of questionable value. Lesion scoring requires considerable expertise. It is inherently subjective and, unfortunately, does not necessarily correlate with protection because lesions may be present in the gut of partially or completely immune birds, even though their weight gain is not depressed.

In some countries, guidelines for avian vaccines have been produced by registration authorities, but specific standards for anticoccidial vaccines in

Guidelines for coccidiosis vaccines

Ideally, any live anticoccidial vaccine should have the following 13 characteristics:

- ✓ Induce protective immunity against economically important species of *Eimeria*
- ✓ Be safe for the target host, non-target animals and humans
- ✓ Not represent an environmental hazard
- ✓ Comprise parasites of normal or low virulence
- ✓ Comprise parasites that remain viable during storage for a reasonable period of time
- ✓ Protect against field strains in geographical areas where the vaccine is used
- ✓ Be administered by a commercially practical method to ensure that as many birds as possible receive an immunizing dose
- ✓ Have no adverse effects on final performance or other production criteria
- ✓ Be compatible with other poultry vaccines
- ✓ Be free from viral, bacterial, mycoplasmal, fungal and chemical contaminants
- ✓ Be cost effective compared with other methods of coccidiosis control
- ✓ Include drug-sensitive lines that may reduce drug resistance in field populations
- ✓ Raise no problems with residues or impose a need for mandatory withdrawal periods



Good biosecurity helps ensure that coccidiosis vaccines are free from contaminants.

poultry apparently have not been published so far. Detailed knowledge of any local requirements is essential to obtain product approval.

The guidelines drafted by the project group provide information on the general requirements of regulatory authorities based on regulations currently applicable in the EU and the US. Topics covered in the guidelines include efficacy requirements, safety and environmental considerations, quality control in terms of purity, phar-

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INDEPENDENT ANALYSIS

Vaccination reduces need for coccidiosis treatment in broilers

By Marco Tamba, DVM, MPVM
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Vaccination of broilers against coccidiosis dramatically reduced the need for coccidiosis treatment, according to the results of an independent analysis conducted in Italy.

The purpose of the analysis was to investigate current coccidiosis control programs in Italy from 2001 to 2004. The analysis was conducted by the Istituto Zooprofilattico Sperimentale della Lombardia e Emilia Romagna and encompassed over 840 million broilers, which represented 55% to 60% of Italian broiler production during the study period.

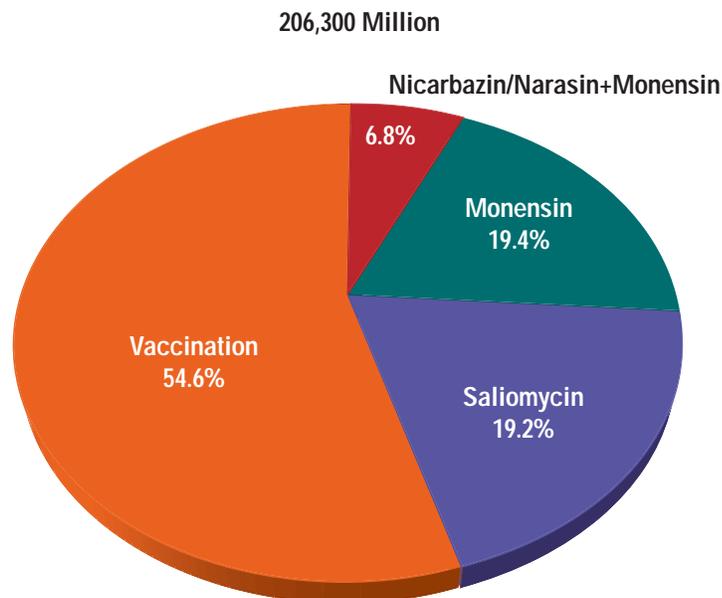
For nearly 80% of the birds, mono or solitary programs rather than combination programs were used for coccidiosis control. The number of dual programs declined and mono programs increased during the study period because nicarbazin was banned by the EU in June 2002.

From 2001 to 2004, the most popular mono control method was vaccination, which was used in over 45% of broilers during the study period. The next most popular mono control program was monensin, used in 19.1%, followed by salinomycin, used in 13.3%.

Of the approximately 20% of broilers that received a dual coccidiosis control program from 2001 to 2004, the leading method used was nicarbazin plus narasin and monensin (8.6%), followed by nicarbazin plus monensin (4.2%).

By 2004, vaccination was used in over 54% of broilers. The next most often used mono coccidiosis control method in 2004 was monensin, used in 19.4%, followed by salinomycin, used in 19.2% (see Figure 1). A dual program consisting of nicarbazin, narasin plus monensin was used in only 6.8% of broilers.

Figure 1. In 2004, vaccination was the most popular mono method of controlling coccidiosis in Italian broilers



CEESA data show antibiotic use declined when coccidiosis vaccination increased

Information from the European Animal Health Study Centre (CEESA) about trends in antibiotic use in the Italian poultry market for treatment of dysbacteriosis has demonstrated that during the time vaccination for coccidiosis increased, the use of three antibiotics used to treat dysbacteriosis declined (see Table 1). More recently acquired CEESA data (Table 2) show that the trend has continued, says Dr. Paolo Sani, poultry manager for Schering-Plough Animal Health, Italy.

The information from CEESA, coupled with the findings from Italy that amprolium and amoxicillin use declined when birds were vaccinated against coccidiosis, indicates that vaccination can provide excellent control of coccidiosis and that it does not increase the risk for intestinal health problems such as dysbacteriosis, including necrotic enteritis, Sani says.

Table 1. Data from the European Animal Health Study Centre indicate that antibiotic usage in the Italian poultry market declined during the time that vaccination against coccidiosis trended upward.

Antibiotic	Antibiotics used 7/04 – 6/05 vs 7/03 – 6/04	Antibiotics used 4/05 – 6/05 vs 4/04 – 6/04	Birds vaccinated 7/04 – 6/05 vs 7/03 – 6/04	Birds vaccinated 4/05 – 6/05 vs 4/04 – 6/04
Betalactamics	1.20%	-5.00%	12.00%	23.00%
Macrolides	-8.10%	-16.50%	12.00%	23.00%
Oxytetracyclines	-13.70%	-25.00%	12.00%	23.00%

Table 2. Recently acquired data from the European Animal Health Study Centre show that in the Italian poultry market, the trend toward less antibiotic use with increased coccidiosis vaccination continued.

Antibiotic	Antibiotics used 10/04 – 9/05 vs 10/03 – 9/04	Antibiotics used 7/05 – 9/05 vs 7/04 – 9/04	Birds vaccinated 9/05 – 10/05 vs 9/04 – 10/04	Birds vaccinated 7/05 – 9/05 vs 7/04 – 9/04
Betalactamics	-7.10%	-11.00%	25.00%	15.10%
Macrolides	-15.20%	-28.10%	25.00%	15.10%
Oxytetracyclines	-15.40%	-21.40%	25.00%	15.10%

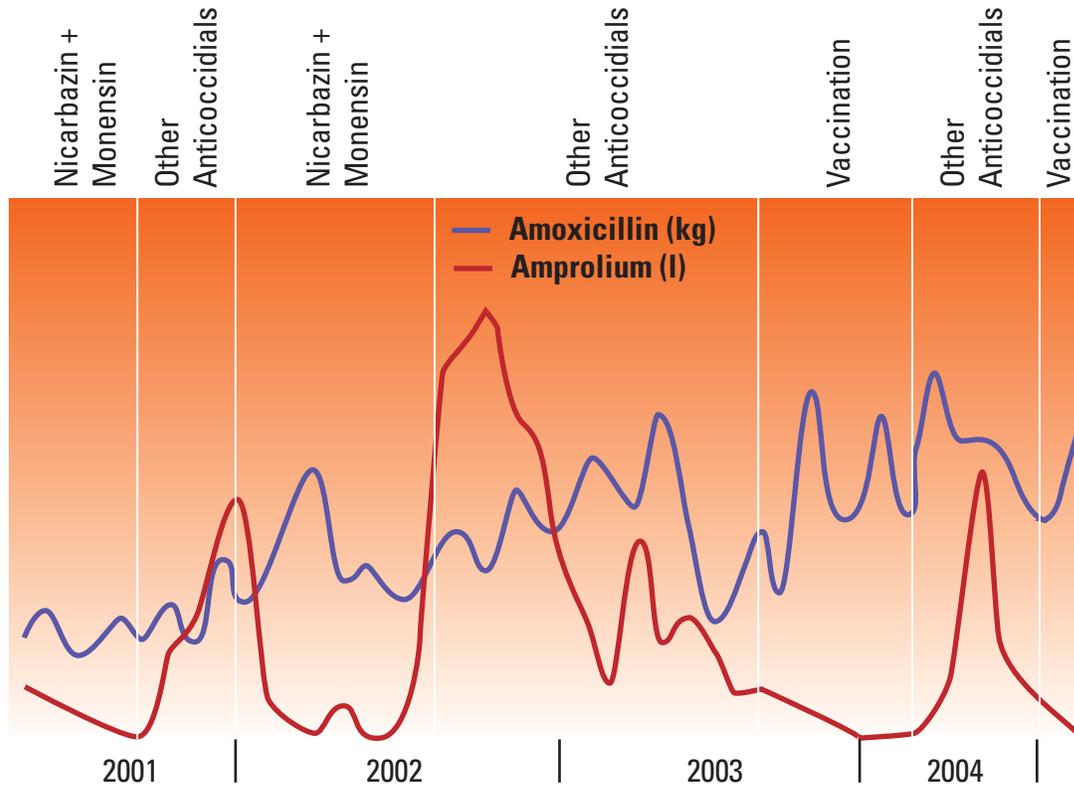
Note: Dates are presented as month/year.

There are two commercial coccidiosis vaccines for broilers available in Europe. Of the two, Paracox-5 is the most widely used in Italy and was the vaccine administered to nearly 100% of vaccinated birds in the analysis.

Paracox-5 is an attenuated vaccine that includes all precocious strains of *Eimeria* affecting broilers. The *Eimeria* strains in Paracox-5 are sensitive to all anticoccidials, including antibiotic ionophores.

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Figure 2. Liters of amprolium for treatment of coccidiosis dropped dramatically and kilograms of amoxicillin for treatment of necrotic enteritis did not change significantly when birds were vaccinated against coccidiosis.



Note: The “other anticoccidials” group included metilchlorpidole+metilbenzoquate and salinomycin, monensin and nicarbazine+narasin and monensin alone. Nicarbazine was a good method of controlling both coccidiosis and necrotic enteritis but was banned from use in the EU as of 2002.

Amprolium treatment declined

One of the most significant findings in the analysis was that amprolium for treatment of coccidiosis declined dramatically when broilers were vaccinated for coccidiosis compared to use of amprolium when other anticoccidials were used. This finding indicates that vaccination is resulting in good coccidiosis control.

Figure 2 shows an example of one Italian producer’s preventive program where amprolium was administered to control clinical coccidiosis and amoxicillin was used to treat necrotic enteritis. Use of amprolium is a good indicator of clinical coccidiosis occurrence: Every peak in amprolium use due to

anticoccidial resistance is followed by a change in the control program, then the use of amprolium decreases until there is an increase in new resistance.

After vaccination was implemented in September 2003, there was a dramatic drop in the use of amprolium, which is evident in the graph.

In contrast, the use of amoxicillin administered for treatment of necrotic enteritis progressively increased throughout the study period. Certainly, problems with bacterial enteritis still exist when broilers are vaccinated for coccidiosis control, but this clinical problem does not appear directly linked to the vaccination.



made there and whether changing feed ingredients would have any negative impact on the performance of vaccinated birds during the period of high oocyst replication. (See accompanying story.)

His next focus is the Economic phase, or about 28 days to market weight. Because vaccinated birds grown on the principles of IDEA should have better immunity and gut health, there's room to economize on the diets in the final phase without compromising performance or returns.

"Going from 28 or 30 days to a market age of around 50 days for the males is quite a long period in the lifetime of the birds," he says. "Is it desirable to keep birds on the same feed for 20 days? From a nutritional standpoint, it might be possible in that period to have more than one feed. As the birds get older, you could reduce the amino acid levels and improve profitability. If you were feeding 45-day-old pullets on the final feed we use in the broilers we're using at the moment, you would argue that you're overfeeding protein."

Not having a coccidiostat in the feed also helps operations remain more flexible when thinning females from their flocks, usually somewhere between 33 to 40 days. The vaccine provides life-long protection, so producers don't have to worry about withdrawal times or leaving the males unprotected for longer periods.

"To be fair, all of the nutritional knowledge we have was developed in medicated birds," ten Doeschate concludes. "I look back on our trial database, and it's all birds that had anticoccidials in their feed. When producers are vaccinating for coccidiosis, there's so much more to look at and hopefully new opportunities at hand. We have to keep the end goal in sight, which is maintaining litter quality and profitable production."

"But every country is different," he adds. "Every country has different challenges and different economics. We can't make a blueprint, but the principles are universal."

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macopoeial sterility, potency, quantification and stability etc., manufacturing practice and, last but not least, necessary documentation.

Purpose

In the foreseeable future, new vaccines are likely to be introduced for protecting poultry against coccidiosis. Some of these vaccines will be produced by companies with an established track record in providing high quality vaccines to the poultry industry but, as pointed out at the 2005 International Coccidiosis Conference held in Brazil, many smaller companies lacking such experience are also likely to be involved. It is important that all commercial vaccines, whatever their source, be produced to the same high standards. For example, in the US,

source flocks used to produce poultry vaccines must be serologically tested to ensure freedom from at least 11 kinds of virus, not to mention *Mycoplasma* and *Salmonella* species.

To reiterate, the purpose of the project group's guidelines is to facilitate the worldwide adoption of consistent, standard procedures for evaluating the efficacy, safety, manufacture and quality control of coccidiosis vaccines for poultry. The poultry industry deserves no less.

Reference

¹ Chapman, HD, Shirley, MW, Williams, RB. Guidelines for evaluating the efficacy and safety of live anticoccidial vaccines, and obtaining approval for their use in chickens and turkeys. *Avian Pathology* 2005;34: 279-290.

Organic meat sales up in US as Americans follow European trend

Producing meat without antibiotics and other drugs has long been advocated by European consumers and regulators and it appears that more Americans are following suit.



Consider the following preliminary findings from the 2006 Manufacturer Survey of the Organic Trade Association (OTA), a US organization reporting on US food trends:

- Organic food sales totaled nearly \$14 billion in 2005, representing 2.5% of all retail sales for food.
- Organic food sales are expected to reach nearly \$16 billion by the end of 2006.
- The fastest-growing organic food in 2005 was organic meat, including poultry, with sales rising by over 55%.

“These findings show there is continued strong growth for organic products, which means additional opportunities for farmers and more choices for consumers,” according to Caren Wilcox, the OTA’s executive director.

The OTA has also forecasted that the fastest growing category of organic product sales would be poultry with an anticipated average annual growth of over 33% through 2008.

To meet this demand, many mainstream poultry operations in the Americas and Europe have already discontinued their use of growth-promoting antibiotics — either voluntarily or because of legislation — and are placing more emphasis on intestinal health programs as a means of controlling disease. Vaccination control has also helped operations reduce or discontinue the use of chemicals or ionophores for coccidiosis control.

Editor’s note: The following news items are from the IX International Coccidiosis Conference in Iguasu Falls, Brazil.

Late production *E. maxima* problems linked to anticoccidial resistance

Problems with *Eimeria maxima* infections late in the production cycle appear to be linked to extensive use of ionophore antibiotics and resulting ionophore-resistant *E. acervulina*, says Dr. Greg F. Mathis of Southern Poultry Research, Inc.

An earlier study suggested that *E. acervulina* can interfere with *E. maxima* colonization. Consequently, Dr. Mathis designed a battery cage study to examine the relationship of *E. acervulina* sensitivity to the ionophore salinomycin and subsequent infection levels with *E. maxima*.

Birds were fed nonmedicated feed or salinomycin at the rate of 60 grams/ton and were then challenged with either a salinomycin sensitive strain of *E. acervulina*, a resistant strain of *E. acervulina* and/or an *E. maxima* field isolate.

The oocyst per bird challenge levels were as follows:

- None (control)
- *E. acervulina* (sensitive strain) 50,000
- *E. acervulina* (resistant strain) 50,000
- *E. acervulina* (sensitive strain) 50,000 plus *E. maxima* 5,000
- *E. acervulina* (resistant strain) 50,000 plus *E. maxima* 5,000
- *E. maxima* 5,000

E. maxima alone caused a 20% weight reduction and 2.70 lesion score, said Mathis.

Salinomycin controlled the sensitive strain with 5% weight reduction and 1.25 lesion score. It did not control the resist-



Mathis

ant strain, resulting in a 22% weight reduction and 2.75 lesion score.

Birds infected with *E. maxima* and the sensitive *E. acervulina* strain had *E. maxima* lesion scores of 2.25. The birds infected with *E. maxima* and the resistant *E. acervulina* strain had *E. maxima* lesion scores of 1.30.

“From the results it can be inferred that *E. acervulina* interfered with development of *E. maxima*. Higher anticoccidial resistance allows more *E. acervulina* colonization, which appears to interfere with colonization of *E. maxima*, and thus indirectly slows *E. maxima* immunity development.

“This increases the chance for late problems with *E. maxima*, possibly explaining an increase in field reports of late *E. maxima* infections where salinomycin has been extensively used,” Mathis said.

Lesser known *Eimeria* species underestimated

Two lesser-known *Eimeria* species in poultry may be underestimated in importance.

One of the species is *Eimeria mitis*. "Mitis" means mild and the species is so named because it has been considered to be of minor significance in poultry, said Dr. Luciano Gobbi, of Schering-Plough Animal Health, Italy.

However, a two-phase trial has shown that, in contrast to its name, *E. mitis* can impair chicken performance and cause losses just like other, better known *Eimeria* species, the veterinarian said.

In the first phase of the study, groups of 14-day-old Ross 508 chickens were infected with either *E. mitis* or *Eimeria acervulina*, a species of coccidia known to have a significant adverse effect on chickens. A third group of birds received saline solution and served as a control. The success of the challenge was confirmed by oocyst counting and shedding. Bird performance was evaluated.

Compared to controls, birds that received either *E. mitis* or *E. acervulina* had significantly lower daily weight gain, feed intake and water consumption, as well as a higher feed conversion ratio and lower final body weight, Gobbi said.

In the second trial phase, three additional groups of 14-day-old Ross 508 birds were challenged with *E. mitis* and *E. acervulina* and were then injected with Pontamine Sky Blue dye to enable evaluation of intestinal mucosa, he said.

Eimeria-infected chickens exhibited color differences in the mucosal surface compared to controls. In fact, only the infected birds had dye leakage between 72 and 144 hours post-infection. The leakage stained intestinal mucosa and gut contents, confirming cell damage and increased gut permeability due to the multiplication of both *Eimeria* species.

In addition, infection with either *Eimeria* species caused significant gut wall thickening due to edema and inflammation, he said.

"The results indicate that *E. mitis* can impair chicken performance and cause losses just like other, well-known *Eimeria* species, despite the name *E. mitis*," Dr. Gobbi said.



Gobbi

Dr. Steve H. Fitz-Coy, also of Schering-Plough Animal Health, reported on *E. mivati*, a coccidial species that some researchers have considered to be a variant of *E. acervulina* or a mixture of *E. acervulina* and *E. mitis*, but not a unique species.

Fitz-Coy identified several field isolates from Georgia and the DelMarVa Peninsula that fit descriptions of *E. mivati*. He selected three of the isolates and sent them with 10 other *Eimeria* species samples to an independent lab for polymerase chain reaction (PCR) assay. The identity of each sample was not known by the lab.

"The only isolates that could not be identified by PCR assay were the *E. mivati* samples," he said. The current primers for identification of *Eimeria* species include *E. acervulina* and virtually all the other *Eimeria* species known to affect chickens — except *E. mivati*, Fitz-Coy said.

The PCR test indicates that *E. mivati* is, in fact, a valid and unique *Eimeria* species, he said.

E. mivati is also "moderately pathogenic" in chickens and, on some occasions, can cause mortality, according to Fitz-Coy. In one study, mortality due to *E. mivati* was 40% in naive chickens, but there was no pathology in hyper-immunized hatch-mates.

Water potential carrier of coccidia to poultry

Drinking water may be a potential carrier of coccidia to chickens, according to a new study.

The study focused on 24 farms that used forage or surface water and did not include farms supplied by treated water, said Reperant Jean-Michael, Le Du Maryse, of the French Agency for Food Safety, Zoopôle Les Croix, Ploufragan, France.

Fecal samples from the farms showed that 75% of the flocks were positive for coccidia. When filters were placed to capture oocysts where water entered the buildings, four of the samples were positive for coccidia, he said.

The species of coccidia found in the water was *Eimeria acervulina*, which was also present in litter from farms in the study, the investigator said.

"These preliminary results suggest that water can be a potential carrier of coccidia for chickens," he said, adding that other forms of water supply could be considered in future studies.

COCCI FORUM

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CocciForum is published by the Worldwide Poultry Business Unit of Schering-Plough Animal Health Corporation, Union, NJ. The editors welcome your ideas and suggestions for news articles concerning coccidiosis management. Send correspondence to **CocciForum**, Feeks Communications, PO Box 9000, PMB 239, Edgartown, MA 02539-9000, USA. E-fax: 928-569-2491, E-mail: JFeeks@prworks.net. Back issues are available online at www.thepoultrysite.com/cocciforum

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