Phytogenic compounds in the management of male poultry infertility

In recent years, the growing demand for poultry meat and eggs has required companies to achieve maximum efficiency in producing day-old chicks. Furthermore, this trend has promoted a strong appreciation in the price of chicks in the global market.

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Thus, one of the most critical tasks of modern poultry production is to optimise the reproductive potential of breeding stock. Fertility, i.e., the number of fertile eggs produced, or chicks hatched per parent bird, has significant economic importance in poultry breeder operations. It determines the profitability of production, then becoming the first and most important requisite of poultry breeding.

The number of fertile eggs produced per hatching dictates the ultimate profitability of hens. However, issues related to management, health, and fertility constantly challenge poultry companies' efforts to achieve optimal levels of reproductive performance. Infertility, in turn, is a significant economic factor in the poultry industry.

Males: a key role in fertility

In the commercial production of avian species, one male is responsible for producing a massive number of fertilised eggs, exceeding 1,000 per year. The proportionally low numbers of males used for natural or artificial insemination mean that their role is even more critical. It is therefore recommended that efforts are concentrated on actions that improve their reproductive functionality.

The quality of being fertile describes the ability to reproduce. The reproductive capacity of males comprises the production of semen containing normal spermatozoa (quality) in adequate numbers (quantity) as well as mating behaviour.

In the case of male poultry, this ability depends on the successful production and maturation of sperm cells in the male reproductive tract, sperm motility, temporary sequestration of sperm in the hen's sperm storage tubules, perforation of the perivitelline layer at multiple sites, and the introduction of condensed DNA into the oocyte via membrane fusion.

Possible impairments

Although the fertility of poultry flocks is associated with both males and females, it is widely recognised that fertility problems are mainly associated with males.

Recent studies show that the male factor accounts for almost 70% of all cases of infertility.

Various factors contribute to male infertility, such as genetic disorders, decreased sperm production, reduced semen quality parameters, and sperm DNA package damage.

Broiler breeder rooster fertility, for example, peaks at 30-40 weeks of age and declines rapidly at 50 weeks of age.

After 45 weeks, the testicular weight, semen volume, sperm concentration, viability, forward motility, polyunsaturated fatty acids in sperm, and antioxidant concentrations decrease, whereas seminal plasma lipid peroxidation increases.

Flock age decreases not only semen quality parameters but also testosterone levels, leading to a significant reduction in libido and frequency of mating behaviour of males.

Oxidative stress impacts

Among several factors recognised as being harmful to organisms, oxidative stress stands out. This imbalance occurs when free radical generation exceeds the capacity of the antioxidant defence mechanism of birds.

This can strongly affect the quality of the semen, the viability and functionality of sperm cells, and even the integrity of the genetic material carried in the sperm.

These alterations are accompanied by a reduction in sperm membrane functionality, mitochondrial activity, sperm-egg penetration, and thus fertility.

In addition, oxidative stress can also affect the production and excretion of reproductive hormones, especially testosterone, and consequently impact spermatogenesis, the process by which sperm are formed in testicular tissues. Moreover, testosterone is essential to maintain male breeders' libido, directly affecting mounting interest, sexual courtship behaviour, and mating frequency throughout the life of the reproductive flock.

Another relevant topic that could also be related to the negative impacts of oxidation stress on sperm is embryonic mortality post-fertilisation. Free radicals inside male reproductive cells cause harmful effects on DNA integrity. Sperm DNA damage is commonly associated with reduced fertilisation rates but also with embryo loss, day-old chick mortality, and mutations leading to unviable or even lower-performing offspring.

Phytogenics as promising support

Anecdotal evidence suggests that plants are rich in substances that could enhance the fertility health of male poultry breeders. This has been widely demonstrated in other species.

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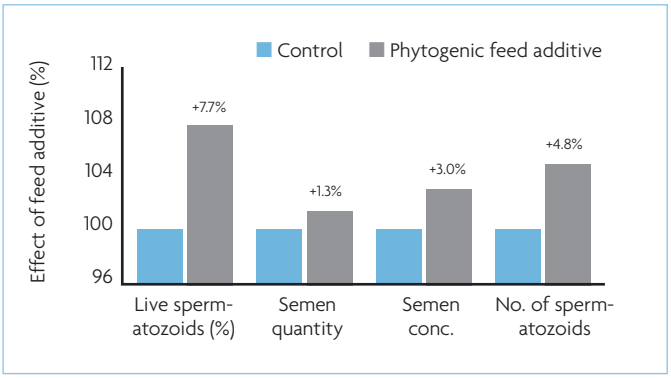

Fig. 1. Effect of a phytogenic feed additive on broiler breeder roosters' semen quality parameters.

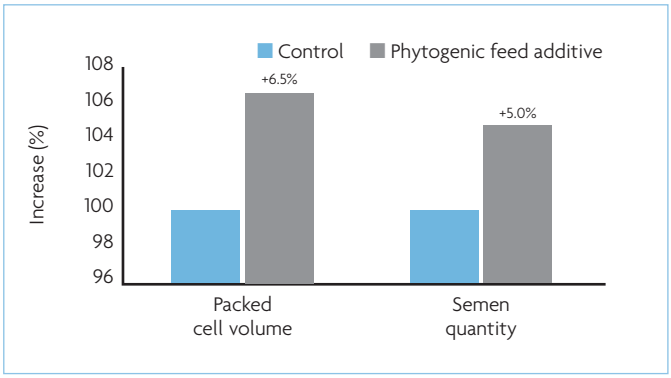

Fig. 2. Increased semen quantity and spermatic volume with the addition of a phytogenic feed additive in toms.

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The scientific literature is relatively abundant regarding the use of active components from plants, so-called phytogenic compounds, to mitigate the harmful effects of oxidative stress on male fertility.

The addition of phytogenic compounds to the diet resulted in the recovery of the most critical fertility parameters and positive results in biological markers that indicate a reduction of the impact of free radicals.

Several phytogenic compounds positively affect spermatogenesis and sperm parameters (motility, count, and viability). They can increase Leydig cell counts and seminiferous tubule diameter, decrease abnormal sperm, improve histopathological recovery, mating stimulation, and increase concentration and motility of sperm.

These compounds can have direct antioxidant effects (for example the scavenging of free radicals by polyphenols) and indirectly by stimulating the animals' bodies to synthesise greater amounts of endogenous antioxidant substances (glutathione peroxidase, superoxide dismutase, etc).

These substances, in turn, protect sperm components from oxidative processes. Consequently, positive effects on embryo survival and offspring health are also commonly observed. Certain phytogenic compounds, such as selected essential oils and saponins, can also contribute directly to hormonal regulation.

Examples of this include increased testosterone production and release, increased expression of specific sperm proteins, and, consequently, enhanced mating behaviour, spermatogenesis, and sperm motility.

A proven natural solution

Based on extensive and in-depth knowledge of phytogenic compounds and their respective effects on the metabolism of farm animals, Delacon, a pioneer and global leader in the production of phytogenic feed additives for animal nutrition, has recently launched a revolutionary natural solution to improve the fertility of breeding males.

This carefully formulated phytogenic feed additive has a unique formulation, specially developed to address reproductive issues and control oxidative stress in this category of breeding males.

In its composition, a comprehensive range of essential oils, flavonoids, and saponins, all obtained from natural sources, provide an increase in the oxidative resilience of semen and its components and optimise reproductive hormonal processes.

Scientific validations have proven the efficacy of phytogenics in improving the reproductive parameters of breeding roosters and toms. These studies showed a significantly higher seminal volume per ejaculation, sperm motility, seminal concentration, and semen quality of males from the group supplemented with phytogenic feed additives, compared to birds that did not receive the additive (control group). It was also reported that improved hatchability, reduced infertile egg percentage, and dead embryo percentage were attributed to the enhanced testosterone level, semen quantity, and viable sperm count following plant extracts addition.

Conclusion

In conclusion, phytogenic feed additives are proven to exert beneficial effects on gametogenic and androgenic functions of poultry males. These compounds also act by regulating hormonal functions, stimulating the activity of seminiferous tubules, and regulating reproductive activity.

For these reasons, phytogenic compounds assert themselves as unique and powerful tools, able to mitigate oxidative stress impacts on male reproduction, optimise testosterone production, directly improve seminal quality parameters, and indirectly increase reproductive stock breeding performance levels. ■