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Overview on some Enteric Bacterial Pathogens isolated from diarrheic calves

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Review Article

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Abstract
Neonatal calf diarrhea is a major problem facing calf industry worldwide, it causes severe losses and affects the animal resources. And still the leading cause of calf mortality in Egypt. thepoor hygienic practices create a good media for different bacterial diseases and life threatening problem resulting in considerable economic loss for dairy farms worldwide. Early postnatal period is a critical window for manipulating the gut microbiota to optimize immunity in individual newborns.
Variety of infectious reasons as bacteria, viruses and parasites. The most common cause of neonatal diarrhea is ETEC strains that produce the K99 adhesion antigen referred to heat-stable enterotoxin either singly or in combination. Salmonellosis is most severe in calves under a month of age. Clostridium perfringens spore- forming anaerobic bacterium that causes a wide range of diarrhea in mammals. Opportunistic pathogens as Klebsiella sp. and Proteus sp. may be from the main causes of the Calf diarrhea. Bovine Rotavirus is higher infection frequency in the first and second weeks of life are consistent with the findings. The parasite Crypto is transmitted via the fecal-oral route when the calf either ingests the oocysts in the feces *or* the calf consumes contaminated water and travels to the small intestine of the calf where the infection begins.

Keywords: *Microbiota , pathogens, virulence , diarrhea, Enterotoxigenic*

Introduction

Neonatal calf diarrhea is a major problem facing calf industry worldwide, it causes severe losses in calves and consequently affects the animal resources. Neonatal calf diarrhea (NCD) is still the leading cause of calf mortality in Egypt, where it affects between 27.4% and 55% of the total deaths in young calves **Younis *et al*. (2009).**
Diarrhea in calves with poor hygienic practices create a very good media for different bacterial diseases and life threatening problem resulting in considerable economic loss for dairy farms worldwide. Furthermore neonatal calf diarrhea is a well-known worldwide cattle disease that causes large economic losses due to high morbidity, mortality, growth delay, and treatment costs. Treatment of this bacteria without scientific basis yield more resistant strains of bacteria especially in small herds with poor scientific medical programs. The calf stage is a critical period for the development of heifers. Newborn calves have low gastrointestinal barrier function and immunity before weaning, making them highly susceptible to infection by various intestinal pathogens. Diarrhea in calves

posses a significant threat to the health of young ruminants and may cause serious economic losses to livestock farms **Du *et al.* (2023)**. The early stages of animal growth have a significant impact on their health, with contact with beneficial microbiota being particularly important. The early intestinal microbiota plays a crucial role in the long-term health of the host, especially in young animals whose gut microbiota is more vulnerable to external influences. The gut microbiota of newborn calves changes in the early postnatal period, and homeostasis of the gut microbiota ecosystem is critical for maintaining gastrointestinal function in calves until early weaning. **Du *et al.* (2023).** Research has shown that the early postnatal period is a critical window for manipulating the gut microbiota to optimize immunity in individual newborns **Torow and Hornef (2017)**. The main age affected by intestinal diseases is calves under 30 days old **(DallAgnol *et al.* (2021).** According to the National Animal Health Monitoring Program for Dairy Products in the United States, diarrhea is responsible for 57% of weaned calf mortality, and 20% calf mortality can result in a 38% reduction in net income **Fentie *et al.* (2020).**

Main enteric causes of calf diarrhea

Diarrhea affects neonatal calves due to a variety of infectious reasons (bacteria, viruses, parasites):

- ***E. coli:***

They are the most significant infectious agents either singly or in combination **Foster *et al.* (2009).** The most frequently recognized causes of diarrhea in calves during their first 30 days of life is ETEC infections during their first four days of life. According to its virulence scheme, Escherichia coli can be divided into six pathogroups: enterotoxigenic *E. coli*, shiga toxin-producing *E. coli,* enteropathogenic *E. coli*, enteroinvasive *E. coli*, enteroaggressive *E. coli*, and enterohaemorrhagic *E. coli* **Kaper *et al.* (2004).** The most common cause of neonatal diarrhea is ETEC strains that produce the K99 (E. coli K99) (F5) adhesion antigen referred to heat-stable enterotoxin **Nataro and Kaper (1998)**. Enterotoxins produced by the the *E. coli* trigger epithelial cells to secrete fluids into the lumen resulting in severe diarrhea **Zhang *et al.* (2022)**. Enterotoxigenic colibacillosis is a major cause of diarrhea in newly born calves less than 3 days of age without an outbreak of diarrhea in calves older than 3 days **Radostitis *et al.* (2007).** It had been reported that low colostrum feeding young calves were significantly associated with E. coli isolation **Ashenafi and Tesfaye (2016)**.

- **Salmonella:**

Cattle is most frequently caused by the serovars *Typhimurium* (*S. typhimurium*) and *Dublin (S. dublin). S. typhimurium* is the most common serotype that affects calves **Cho and Yoon (2014).** Salmonellosis is most severe in calves under a month of age **Bicnell and Noon (1993).** Salmonella-related diarrhoea is watery and mucoid with blood and fibrin present **Fossler *et al.* (2005).** Salmonella pathogenicity island SPI-1 and SPI-5 including invA and sopB genes are known to influence the type III secretion system, and are mainly responsible for Salmonella induced diarrhea in calves **Treuer and Haydel (2011).**

- ***Clostridium perfringens*:**

Gram-positive, spore- forming anaerobic bacterium that causes a wide range of diseases in mammals and birds **Van *et al.* (2004).** Recently seven different toxigenic types are categorized this bacteria as (A, B, C, D, E, F and G) based on the production of four major toxins: alpha (α), beta (β), epsilon (ε), iota (ι) and two minor toxins named as enterotoxins (cpe) and net B **Petit *et al.* (1999)**. Type A strains produce α toxin alone, type B stains produce α, β, and ε toxins; type C strains produce α and β toxins; type D strains secrete α and ε toxins; and type E strains produce α and ι toxins, type F strains produce α and enterotoxins (cpe) and type G strains produce α and net B. Among these groups, type C has been frequently reported in conjunction with calf diarrhea **Rings (2004).**

- **Klebsiella sp. and Proteus sp**:

Calf diarrhea may be caused by these opportunistic pathogens **Shobhamani *et al.* (2005)**.

Bovine Coronavirus (BCoV):
BCoV infections are more likely causes of calf diarrhea from day five to twenty **Santín *et al.* (2008) and Brunauer *et al*. (2021).**

- **Bovine Rotavirus (BRV):**

The average age of infected calves (8.5 days) and higher infection frequency in the first and second weeks of life are consistent with the findings of **Bartels *et al*. (2010),** who attributed reduced BRV-related diarrhea in older calves to increasing natural resistance

- ***Cryptosporidium parvum* (CP):**

The parasite Crypto is transmitted via the fecal -oral route when the calf either ingests the oocysts in the feces *or* the calf consumes contaminated water **Cho and Yoon (2014).** Importantly, a calf can shed the oocysts up to a week after it recovers from diarrhea. Once ingested, the oocyst is activated by the pH and temperature in the calf's abomasum and four sporozoites are released **Thomson *et al.* (2017).** *Cryptosporidium parvum* travels to the small intestine of the calf where the infection begins.

- **Symptoms**

Diarrhea causes varying degree of dehydration, gastroenteritis, body fluid loss and various body fluid changes, also diarrhea and dehydration in calves has a harmful effect on general health condition, gastrointestinal tract, body fluid, blood, serum and fecal contents. **Elsheikh *et al.* (2012***)***.** Enteritis among newly-born calves causes high morbidity and mortality rates which resulted as large economical losses in Egypt. **Ashraf (2007).**

Diagnosis:
Traditional diagnosis:
From calves suffering from diarrhea fecal samples collected directly from the rectum and transferred without delay to the laboratory in a separate clean sterile plastic bag in an ice box and kept in retail package under complete aseptic condition at 4°C for a maximum of 1 week until bacteriological isolation and identification of bacteria spp. Collected samples were inoculated in suitable fluid media (preenrichment & enrichment) and incubated aerobically at 37°C for 24 h followed by culture onto suitable solid media (mackonkey agar, blood agar, E M agar and XLD agar medium) and incubated aerobically for 24-48 h at 37°C the pure isolated colonies were confirmed based on their morphology, cultural and biochemical tests then to determine the sensitive antibiotic against each isolate using standard bacteriological procedures described in **Cruicks hank *et al.* (1975)** and **Octavia and Lan (2014)**.

Molecular diagnostics:
ost often Polymerase Chain Reaction (PCR)-based tests, are becoming more common in diagnostic laboratories for detecting enteric pathogens and prevent their own challenges in interpretation **Espy *et al.* (2006).** PCR methods are usually more sensitive and may detect lower levels of pathogens that may not be causing disease due to age resistance or those arise from cross-contamination from one calf to another. PCR methods also can detect the dead or stressed bacteria or even in the presence of antibody-antigen complexes **Blanchard (2012).**

Prevention and control
It is challenging to successfully control NCD because of its multifactorial nature **Cho and Yoon (2014).** Identification of the etiological and predisposing variables for calf diarrhea is crucial in order to devise preventive measures and reduce losses during the initial months of life **Lorino *et al*. (2005).**
Vaccination of pregnant dams at late stage of pregnancy is essential by suitable vaccines which produce antibodies secreted in colostrum that protected new born calves from infection during the first few weeks of their life **Meera and Murashe (2017) and Joe Armstrong (2023).**

Treatment:
True bacterial diagnosis and choice of suitable antibacterial drug is the first step to solve this complicated problem. Then good apply control and complete the successful medical program to avoid recurrence of these economic losses. For successful and true line of treatment sensitivity test should be applied to detect the effective antibiotic for each field strain isolate and

to avoid bacterial resistance complication **Nagati *et al.* (2023).**

Conclusions

It is very important to establish a healthy calf gastrointestinal microbiota using early accurate diagnosis and an effective treatment as Small calves are more susceptible to different enteric causes of diarrhea including bacteria (*E. coli,* Salmonella and *clostridium perfringens),* virus (Rota and Corona viruses) and parasites (*Cryptosporidium parvum)* leading to high morbidity and motality rate ends with high economic losses so rapid detection of these causes with specific detection of accurate antibiotic in early stage of disease sure help in treatment and decrease these losses.

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