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USE OF POLYVALENT COW COLOSTRUM IN THE PREVENTION OF ENTERIC INFECTIONS IN CALVES AND PIGLETS

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Résumé

UTILISATION D'UN COLOSTRUM BOVIN POLYVALENT POUR LA PREVENTION DES INFECTIONS ENTERIQUES CHEZ LES VEAUX ET LES PORCELETS. — Le colostrum de vaches immunisées contre des souches entéropathogènes d'*Escherichia coli* protège bien les porcelets et les veaux contre les infections entériques colibacillaires. Les immunoglobulines bovines (IgG₁) et leurs fragments précipitables persistent dans l'intestin grêle des porcelets pendant 6 heures après l'administration. La fragmentation par les enzymes protéolytiques des IgG₂ colostrales porcines, qui se produit surtout dans l'intestin grêle, survient à un rythme plus rapide que celui des IgG₁ hétérologues du colostrum bovin. Le colostrum de vaches immunisées contre la gastroentérite transmissible (TGE) par administration intramammaire protégeait le porcelet nouveau-né du virus virulent de la TGE administré par voie orale.

La prévention des infections entériques colibacillaires chez les porcelets et les veaux en cours d'allaitement est basée en Tchécoslovaquie sur la vaccination des vaches et des truies gestantes et sur une protection passive supplémentaire par administration orale de colostrum immun liquide ou séché, ou de sérum de vaches vaccinées avec des vaccins polyvalents préparés à partir de souches entérogènes d'*E. coli*.

If newborn piglets and calves kept under conventional conditions are deprived of colostrum, they may develop septicaemia and die. Moreover, a small number of piglets and calves that receive adequate amounts of colostrum, develop septicaemia as a result of hypogammaglobulinaemia or agammaglobulinaemia (Fey, 1971) for reasons not yet fully understood. Parenteral administration of immunoglobulins to agammaglobulinaemic neonatal animals may protect them from septicaemic states but, like cir-

culating colostrum antibodies, has no practical effect on intestinal immunity. On the other hand, specific colostrum, milk or serum immunoglobulins administered to the young orally at the time that the intestine has been closed to the absorption of immunoglobulins, inhibit enteral infection, but do not prevent the development of septicaemia (Logan *et al.*, 1974).

The differences between the pathogenesis of septicaemia and local enteric infections emerge from the comparison of coli septi-

caemia and enteric coliinfection in piglets and calves which represent two distinct nosological entities :

(1) Enteric coli infections affect piglets and calves in the first week after birth and at two weeks after weaning. The causative agent, an enteropathogenic *Escherichia coli* serotype, is present only in the intestinal lumen and does not enter the bloodstream. The earlier concept that the enteric form changes to a septic one was erroneous.

(2) Septicaemic coli infections are conditioned by hypo- or agammaglobulinaemia. The portal of entry for the development of septicaemia is the upper respiratory tract and the tonsils. Strains that produce sepsis are generally not enteropathogenic, are resistant to complement, but are lysed by complement activated with IgM.

This would imply that IgM plays an important role in the protection against colisepticaemia, whereas the other colostral immunoglobulins, IgG and IgA, are involved mainly in local immunity, when supplied through whole colostrum. However, administration of these immunoglobulins in purified form has a much lower protective effect (Logan *et al.*, 1974).

The value of oral administration of specific immune sera or gamma globulins or possibly whole colostrum in the prevention of enteric infections is beyond dispute (Kohler, 1967 ; Glawischnig and Hirtl, 1970 ; Brandenburg and Wilson, 1973 ; Logan *et al.*, 1974 ; Ulmann *et al.*, 1973). In transmissible gastroenteritis (TGE), a protective effect was ascribed exclusively to milk IgA whereas serum immunoglobulins proved ineffective (Abou Youssef and Ristic, 1975 ; Bohl and Saif, 1975 ; Stone *et al.*, 1974 ; Štěpánek *et al.*, 1975).

In the prevention of enteric coli infections in weaned calves and piglets, very good results were obtained in Czechoslovakia with polyvalent hyperimmune serum prepared from the blood of slaughtered cattle and pigs immunized with polyvalent vaccines (Salajka *et al.*, 1975 ; Ulmann *et al.*, 1973).

A satisfactory protective effect against enteric coli infections of piglets was also obtained with bovine, i.e. heterologous immune serum under both experimental and operational conditions. These results led to the preparation of polyvalent hyperimmune or immune preparations from bovine serum

and colostrum against other enteric infections of the piglet.

Our attention was focused on cow's colostrum, the surplus of which provides a convenient source of biological material for preparation of effective immunopreparations in view of its high specific antibody content. With this in view, we studied the fate of bovine and porcine colostral IgG in the digestive tract of suckling piglets aged 2 and 14 days with particular reference to its persistence in the intestinal lumen and its possible protective effect (Procházka *et al.*, in press). The main points emerging from these experiments were as follows :

(1) Labelled IgG and its precipitable fragments persist in the upper part of the gastrointestinal tract during the first two hours after administration and reach the large intestine 4 to 6 hours after administration.

(2) The presence of IgG and its fragments in the stomach and small intestine can be detected between 1 and 6 hours after administration.

(3) Labelled heterologous IgG of bovine colostrum persisted in the stomach and small intestine of piglets aged 2 and 14 days for 1 to 6 hours after administration in an amount exceeding that of homologous IgG of porcine colostrum.

(4) This implies that the proteolytic breakdown of homologous IgG, which occurs predominantly in the small intestine, proceeds at a higher rate than that of heterologous IgG.

The protective effect of heterologous colostrum on the intestinal mucosa of piglets was confirmed in another experiment using TGE as a model. Hyperimmune colostrum whey was obtained from bovine colostrum taken during the first 24 hours after parturition from cows that had been infected with TGE virus by intramammary administration before calving. Colostrum whey having a VN titre of 512 was filtered through a Seitz filter and given to colostrum-deprived 4-day-old piglets at intervals of 2 and 4 hours. Native whey was given at 2-hour-intervals to suckled piglets of the same age left on the non-immune sow (Štěpánek *et al.*, 1977). Twelve hours after the institution of the treatment both the suckled and colostrum-deprived piglets were infected with virulent virus prepared from organs of infected

piglets. Two piglets serving as controls in the group of colostrum-deprived piglets became severely ill and died. The experimental piglets of this group treated with colostrum whey developed diarrhoea 1 to 3 days later and the course of the disease was mild. Death occurred only in the group treated with colostrum whey at 4-hour-intervals where one piglet died and the remaining 10 animals recovered within 3 to 4 days. It is obvious that oral administration of colostrum whey prevented the development of disease after single infection and that the experimental piglets became ill as a consequence of massive reexposure to virus shed by control nonprotected piglets kept in the same environment. A similar pattern was seen in the group of suckled piglets.

Accordingly, the prevention of enteric infections in piglets and calves in Czechoslovakia is based on the promotion of general immunity of pregnant cows and sows and on passive protection of the intestinal mucosa of suckling piglets and calves through colostrum and milk antibodies. Early weaned as well as colostrum-deprived and artificially reared piglets are protected by administration of immunopreparations prepared from homologous or heterologous serum and heterologous colostrum. Most experience so far has been obtained with the prevention of enteric coli infections (Salajka *et al.*, 1975). Sows and cows are vaccinated with polyvalent vaccines prepared from 6 to 8 pa-

thogenic serotypes with the composition of these vaccines being changed according to the occurrence of pathogenic serotypes in the affected areas.

The approach based on systematic vaccination of pregnant cows and sows permitted us to reduce considerably the incidence of diarrhoea and death losses due to enteric coli infections in suckled piglets and calves (Salajka *et al.*, 1975). The protection of piglets and calves after weaning is based on oral administration of biopreparations either liquid or dried.

Unlike antibiotic and chemotherapeutic treatment this approach respects the physiology of the piglet and calf, since it replaces the supply of antibodies through maternal milk which, under new rearing practices, is stopped abruptly by weaning at a time that piglets and calves are still incapable of producing a sufficient degree of immunity by themselves.

Recently, dried immune bovine blood serum and colostrum whey have been used as specific immunopreparations to protect weaned piglets and calves from enteric coli infections under conditions of both conventional rearing and artificial rearing of colostrum-deprived animals.

The results obtained so far have been satisfactory. The incidence of diarrhoea and death losses were reduced and the rate of gain in body weight was increased.

Summary

Colostrum of cows immunized with a polyvalent vaccine against enteropathogenic strains of *Escherichia coli* gave good protection to piglets and calves against enteric coli infections. Bovine immunoglobulin (IgG₁) and its precipitable fragments persisted in the small intestine of piglets for 6 hours after oral administration. The proteolytic breakdown of porcine colostrum IgG₂, which occurs predominantly in the small intestine proceeded at a higher rate than that of heterologous bovine colostrum IgG₁. Colostrum of cows immunized with transmissible gastroenteritis (TGE) virus by intramammary administration protected newborn piglets from virulent TGE virus on oral administration. The prevention of enteric coli infections in suckling piglets and calves in Czechoslovakia is based on vaccination of pregnant cows and sows and on additional passive protection of weanlings by oral administration of dried or liquid immune colostrum or serum of cows vaccinated with polyvalent vaccines prepared from enteropathogenic strains of *E. Coli*.

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