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Oral administration of pectin-rich plant extract enhances C3 and C4 complement concentration in woman colostrum

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Abstract – C3 and C4 components of the complement are normally present in human colostrum. These compounds are natural antibacterial agents. Pectin-rich plant extracts have been shown to induce prolactin release and milk synthesis when administered by the oral route in rat. In the present work, extract from a plant rich in pectin, *Gossypium herbaceum* was given orally to women 2 days after parturition. The extract enhanced concentration of C3 and C4 in colostrum but did not modify the total hemolytic complement activity (TCH50). No change in the concentration of the three compounds was observed in serum of the treated women. Control experiments showed that a treatment by placebo had no effect on colostrum composition. These data suggest that pectin-rich plant extracts favour transfer of C3 and C4 from blood to colostrum by an unknown mechanism. This observation suggests that some plant extracts might be used to reinforce the antibacterial activity of human colostrum. © Inra/Elsevier, Paris

gossypium / linum / serum / colostrum / C3 / C4 / TCH50

Résumé – L'administration orale d'extraits de plantes riches en pectines augmente la concentration du complément en C3 et C4 dans le colostrum humain. Les composés C3 et C4 du complément sont normalement présents dans le colostrum humain. Ces composés sont des agents antibactériens naturels. Des études antérieures ont montré que des extraits de plantes riches en pectines induisent la sécrétion de prolactine et la synthèse de lait lorsqu'ils sont administrés par voie orale chez le rat. Dans le travail rapporté ici, un extrait riche en pectine extrait de *Gossypium herbaceum* a été donné par voie orale à des femmes deux jours après la parturition. L'extrait a augmenté la concentration de C3 et C4 dans le colostrum mais il n'a pas modifié l'activité hémolytique totale du complément (TCH50). Aucun changement de la concentration des trois composés n'a été observé dans le sérum des femmes traitées. Des expériences contrôle ont montré qu'un traitement par un placebo n'a pas d'effet sur la composition en complément du colos-

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trum. Ces données suggèrent que les extraits de plantes riches en pectines favorisent le transfert du C3 et du C4 du sang dans le colostrum par un mécanisme inconnu. Cette observation suggère que certains extraits de plantes pourraient être utilisés pour renforcer l'activité antibactérienne de colostrum humain. © Inra/Elsevier, Paris

gossypium / linun / serum / C3 / C4 / TCH50

1. INTRODUCTION

Colostrum and milk are known to contain a certain number of antibacterial agents. Their biochemical structure and their mode of action are quite different. Among these compounds are immunoglobulins (mainly IgA in human and IgG in cow), lactoferrin, transferrin and oligosaccharides in human [4]. The C3 and C4 components of complement which have antibacterial activity are present in human colostrum [1].

Various plant extracts are traditionally used to stimulate some biological functions in human. Milk secretion is known to be stimulated by extracts from *Gossypium herbaceum* and other plant extracts [7, 9, 12]. Beer is also commonly used to enhance milk secretion in lactating woman. Beer contains a compound which stimulates prolactin secretion [3, 6]. The compounds which are responsible for the lactogenic activity of plant extracts have been identified. Many plant extracts which stimulate prolactin release and milk secretion are rich in pectin [8, 10].

Pure pectins and pectic acid can mimic the action of plant extracts [7–10]. The active compounds present in beer have been shown to derive from malt and to be β-glucan [6].

Apart from their lactogenic activity, pectins have been shown to have antiallergic and immunomodulating properties [5, 13]. The exact mechanism of action of pectins and β-glucan is not known. Recent experiments have shown that due to their carbohydrate structure, they bind to plasma membrane lectins. This binding seems to trigger a more or less specific secretion of various compounds from the target cells.

In the present work, extracts from a pectin-rich plant have been used to tentatively enhance C3 and C4 concentration in women's colostrum. A plant, *Gossypium herbaceum* [7, 12] has been shown to contain substances capable of stimulating prolactin release in sheep. It is therefore a candidate to stimulate secretion of some milk compounds.

2. MATERIALS AND METHODS

2.1. Preparation of plant extract

The plant extract was prepared essentially as described in our previous work [7–10, 12]. In brief, the seeds were homogenized in water. The mixture was heated to 100 °C and cooled. The aqueous fraction obtained by centrifugation was lyophilized and kept until use.

2.2. Measurement of pectin concentration

Lyophilized plant extract (0.2 g) were dissolved in distilled water and the solution was boiled for 20 min. After filtrating, 2–3 volumes of ethanol were added. The mixture was kept overnight at 4 °C. Pectin was insolubilized and appeared as a spongy form precipitate. The insoluble material was sedimented by a centrifugation and redissolved in 10 mL of boiling water. Pectin concentration in the solution was evaluated using the phenol sulfuric method [2].

2.3. Measurement C3, C4 and TCH50 concentration

The concentrations of the complement compounds were evaluated using Agar plants SR1D (single radial immunodiffusion) produced by Baharafshan (Iran).

2.4. In vivo treatment by the plant extracts

The volunteers were chosen from lactating mothers, 20–24 years old, 48 h post-partum. They all had normal delivery and did not use any kind of drugs. The volunteers were divided into two groups and each group was composed of four women. In all cases, the extracts were administered by the oral route. Group 1 received a placebo containing milk, sugar and cacao. Group 2 received the placebo mixture plus 20 g of *Gossypium* extract.

The sampling started at 9 a.m. Blood samples were collected 10 mins before and 30, 60, 90 and 120 mins after the oral administration. Colostrum samples were collected 10 mins before and 120 mins after the oral administration.

3. RESULTS

3.1. The pectin concentration in the plant extract

Previous work has shown that Gossypium seeds are rich in pectin and that various extracts enriched in pectin are able to stimulate prolactin release in sheep [7]. Measurements of pectin in *Gossypium* extract indicated that it contained 27 ± 0.7 mg in 1 g of crude extract.

A 20 g sample of *Gossypium* extract corresponding to 520 mg of pectin was added to the placebo mixture.

3.2. Effect of the plant extract administration on C3, C4 and TCH50 levels in serum

The administration of placebo did not modify the concentration of the complement compounds in the serum of women (*figure 1*). The addition of *Gossypium* extract was without any effect (*figure 1*).

3.3. Effect of the plant extract administration on C3, C4 and TCH50 levels in colostrum

The concentration of the complement compounds in colostrum samples were measured 10 mins before and 120 mins after the administration of the extracts. In no case was TCH50 found in colostrum.

The placebo did not alter C3 and C4 concentration in milk (*figure 2*). The *Gossypium* extract enhanced quite significantly the concentration of C3 and C4 in colostrum (*figure 2*).

4. CONCLUSION

The data reported here confirm that *Gossypium* extract is rich in pectin. This observation is in agreement with previous studies [7, 9, 12]. The extract stimulated C3 and C4 secretion in colostrum of women.

The concentration of C3 and C4 was not altered in serum under the action of the plant extract. This suggests that the synthesis of the complement components was not modified by pectin. Instead, the transfer of C3 and C4 from blood to colostrum was most likely stimulated by the plant extract. The mechanism of this stimulation is not known. In a study which will be published elsewhere (Sepehri et al., unpublished) it was shown that the *Gossypium* extract administered orally enhanced prolactin level in blood of women. The fact that C3 and C4 secretion in colostrum was stimulated by prolactin cannot presently be ruled out. Pectin has been shown to stimulate not only prolactin secretion [11] but also GH, LH, ACTH and casein when added in vitro to

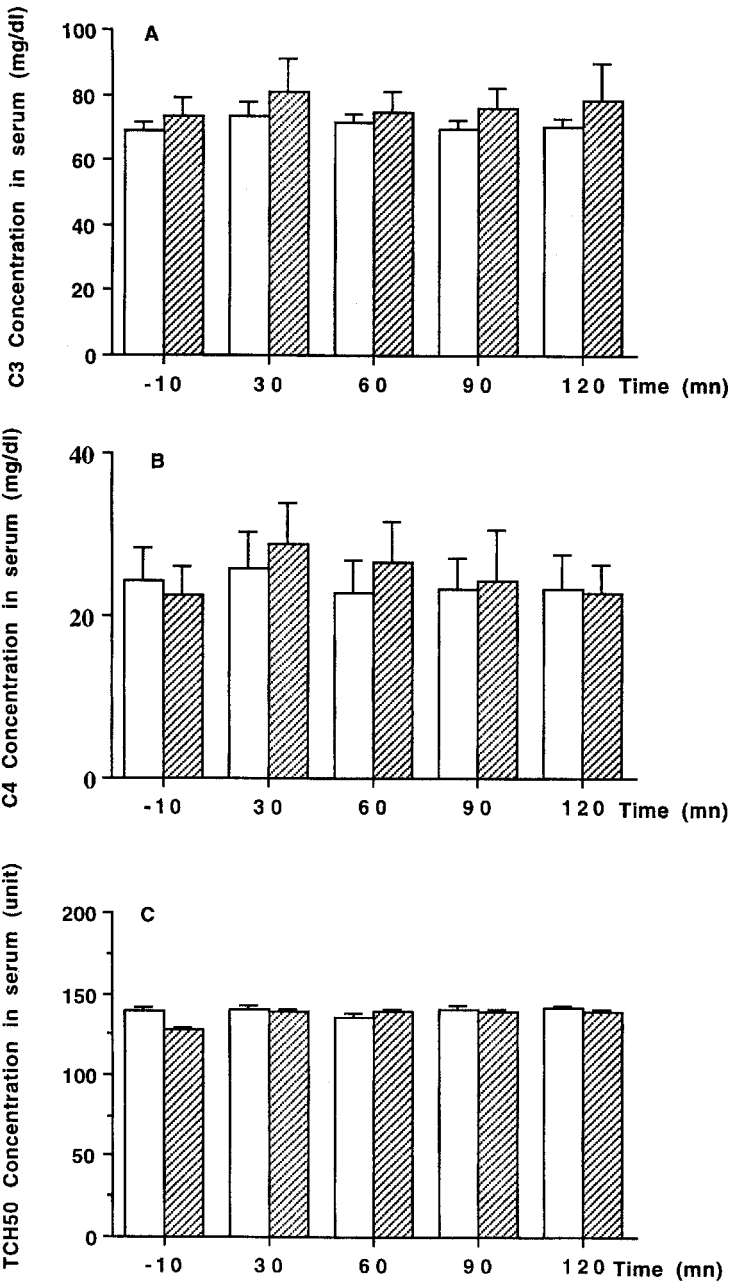

Figure 1. Effect of plant extracts on concentration of C3, C4 and TCH50 in serum. Placebo (□), *Gossypium* extract (20 g) (■) was administered orally at time 0. The concentrations of C3, C4 and TCH50 were determined at the different times indicated on the figure. Results are the mean ± SEM of four independent experiments. A) C3 concentration, B) C4 concentration, C) TCH50 concentration.

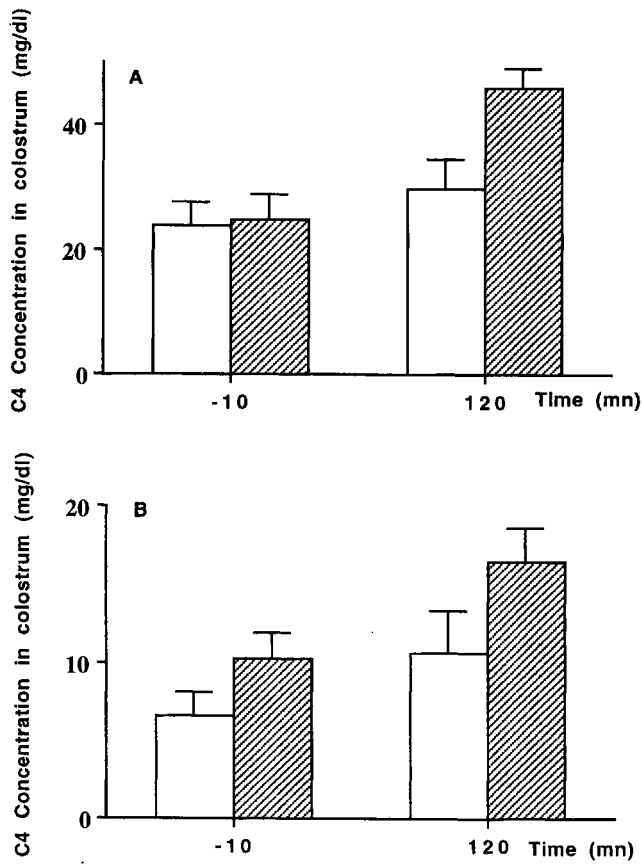

Figure 2. Effect of plant extracts on concentration of C3 and C4 concentration in colostrum. Placebo (□), *Gossypium* extract (20 g) (■) was administered orally at time 0. The concentration of C3 and C4 was determined 10 min and 120 min after the administration of the extracts. Results are the means ± SEM of four independent experiments. A) C3, B) C4 concentration.

isolated tissues. The direct action of pectin on C3 and C4 secretion in colostrum is therefore also conceivable.

From a practical point of view, the data reported here suggest that the content of colostrum in C3 and C4 and therefore the antibacterial property of colostrum may potentially be enhanced by the oral administration of pectin-rich plant extracts.

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REFERENCES

[1] Bernaco M.M., Liu I.K., Willits N.H., Hemolytic complement activity and concentration of third component during maturation of immune responses in colostrum, Am. J. Vet. Res. 55 (1994) 928–933.

[2] Buysse J., Merku P., An improved to quantity sugar of plant tissue, J. Exp. Bot. 44 (1993) 261–267.

[3] Carlson H.E., Wasser H.L., Reideberger R.D., Beer induced prolactin secretion, J. Clin. Endocr. Metab. 60 (1985) 673–677.

[4] Newman J., How breast milk protects newborns, Sci. Am. Dec. (1995) 58–61.

[5] Sawabe Y., Nakagomi K., Iwagami S., Suzuki S., Nakazawa H., Inhibitory effect of pectic substances on activated hyaluronidase and histamin release from mast cells, Biochim. Biophys. Acta 1137 (1992) 274–278.

[6] Sawadogo L., Houdebine L.M., Identification of the lactogenic compound present in beer, Ann. Biol. Clin. 46 (1988) 129–134.

[7] Sawadogo L., Houdebine L.M., Gueguen J., Berot S., Mise en évidence des propriétés galactogènes de divers extraits de graine de coton, Bull. Med. Trad. 2 (1988) 133–146.

[8] Sawadogo L., Houdebine L.M., Thibault J.F., Rouau X., Ollivier-Bousquet M., Effect of pectic substances on prolactin and growth hormone secretion in the ewe and on the induction of casein synthesis in the rat, Reprod. Nutr. Dev. 28 (1988) 293–301.

[9] Sawadogo L., Houdebine L.M., Thibault J.F., Rouau X., Mise en évidence d'une activité lactogène dans des extraits végétaux, Bull. Méd. Trad. 2 (1988) 19–30.

[10] Sawadogo L., Thibault J.F., Rouau X., Gueguen J., Berot S., Ollivier-Bousquet M., Sepehri H., Houdebine L.M., in: Martinet J., Houdebine L.M. (Eds.), Action lactogène de certains extraits de plantes, Biologie de la Lactation, Édition Inra - Inserm, 1990, pp. 477–489.

[11] Sepehri H., Renard C., Houdebine L.M., Beta-glucan and pectin derivatives stimulate prolactin secretion from hypophysis in vitro, Proc. Soc. Exp. Biol. Med. 194 (1990) 193–197.

[12] Sepehri H., Kann G., Houdebine L.M., Pouvoir lactogène potentiel de quelques extraits de plantes iraniennes, Cahiers/Agricultures 1 (1992) 35–39.

[13] Zaporozhets T.S., Besednova N.N., Liamkin G.P., Loenko I.U.N., Popov A.M., Immunomodulating properties of pectin from sea water zostera, Antibiot. Khimioter 36 (1991) 31–34.