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Effect of Exogenous Porcine Somatotropin on Growth in Rats

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ABSTRACT

The growth effect of PST liposome on rats was conducted in this experiment in a sustained-release formulation. Both PST and PST liposome stimulated growth performance of rats and differences between treatment groups and control group was obvious. PST liposome, however, demonstrated great sustained-release effect, which lasted more than seven days.

Key Words: Porcine somatotropin (PST); Liposome; Growth effect; Reverse evaporating; Sustained-release

INTRODUCTION

Growth hormone (GH) or somatotropin (ST) is a single polypeptide chain consisting of 191 amino acids (around 22,000 Da), varying considerably between species. The growth promoting effect of GH was shown in rats as early as in the 1920s by Evans and co-workers. They demonstrated that GH increases weight gain (Evans & Simpson, 1920) and stimulates protein accretion concurrent with a reduction in fat deposition (Li-feng Chen *et al.,* 1997).The effect was not studied in farm animals until the 1950s. For many years, it was not possible to apply this knowledge to practice due to limited supply of GH. However, with the development of recombinant DNA techniques this has now changed, and porcine GH has been approved since 1995 (Sejrsen *et al.,* 1995; Yihui Zheng, 1996) for commercial use in growing pigs in Australia. Recombinant bovine GH (rbST) is widely used to stimulate milk production in cows, but it is not used commercially for growth promotion. GH cannot be administered orally, but by injection. For cattle, sustainable release formulations for monthly administration are on the market.

Liposome was small vesicle which was similar to biofilm, it was first found by English scholar, Bangham and Standish, when they studied phospholipid. The partitioning of drugs between cell membranes and aqueous solutions has been widely studied using liposomes, which are model membranes with a lipid bilayer structure. Multilamellar liposomes (MLVs) have been used in a sedimentation method to study drug–membrane interactions and to determine the membrane partition coefficient for drugs (Wolverton *et al.,* 1992).

Liposome can be decomposed in bodies, no poison and immunity. What's more, as a kind of drug-carrier it can reduce the toxicity of drug. In the last years researchers have attached great importance to liposome and rapid progress have been taken .PST encapsulated with liposome could not only protect drug from digestive loss but promote absorption with the character of sustained-release effects.

MATERIALS AND METHODS

Porcine somatoptropin (provided by Lupeng Bio-technological Center/Shenzhen PRC.); ZFA-1 Revolving evaporator (supported by shanghai glass instrument second factory); Utrasonic processor (intensity 400W, frequency 20 KHz) (Sonics & Materials Vibra Cell; UV755B spectrophotometer (Shanghai fine science instrument factory).

Experiment animals. The number of S-D male and female rat was same, (from FuDan Univerisity medicine school, shanghai)

PST liposome preparation (Qi neng Ping, 1999; Zongxiang, 2001). PST liposome was prepared with the method of reverse evaporating □Weighing some Lecithin, cholestrol and octadecane (Fluka) according to the ratio of molecule(7:2:1) and transferring them to a round flask; □adding Ether (30mL) into it and making it completely resolved, then resolve PST in PBS solution (25ml,0.01mol/L); □ the solution was treated 5min in ultrasonic waves (intensity 40%, at 1s intervals); □decompress evaporation (38□) into a gum or membrane state then with 25 ml PBS (0.01 mol) wash down the membrane.□Decompress evaporation until removing all ether, 5 min centrifugation at 3000 rpm to get rid of superfluous PST, then store the product with N2 filled .

Growth effect of PST liposome on S-D rats (Zongxiang *et al.,* 2001). Rats were fed preliminarily for 10 days on document' data. They were grouped randomly into 4 groups with 16 rats per row. Females and males were in half, and bred in different boxes (differences of primary bodyweight less than 3 g in the same row). The control group injected physiological saline (1mL) in the abdominal cavity. Group1 was injected with pure PST daily, 1mL for each (1.2mg/mL); Group 2 was injected once every 7 days (8.4mg/ml); Group 3 was treated every 14 days (16.8mg/mL). All rats were fed under invariable temperature and humidity, allowing the free intake. The wood scraps were changed everyday. From day 2, the rats were weighed at 8:00 AM every morning and injected drug in the abdominal cavity according to experimental

requirements.

RESULTS

Data were subjected to analyses of ANOVA and effects of PST treatment on body weights were shown in the Tables I to III.

Administration of PST to female and male rats both in pure PST and PST liposome had demonstrated that PST increased weight gain. When the dosage was in a range of 5-6 mg/kg (according to bodyweight), there were no deaths. At this level, the use of PST can be regarded safe and positive. From Tables I to III (7 days later) the differences between the control and trial rows are remarkable ($P<0.05$), while differences between the experimental groups aren't distinct. Day 14, the weight gains made by these treatments trial group1, group 2 relative to controls were obvious ($P<0.05$), while group 3 showed no significant difference relative to the control group ($P>0.05$). PST liposome had indicated great sustained-release effect and the period lasted more than seven days. The results were agreement with the research of Li Zhen's (Lizhen GaoMing *et al.* (2003).

DISCUSSION

The range of biological effects PST are extraordinary and have been discussed previously (Rehfeldt *et al.*, 2001) the early work by Larry established that PST worked in pigs. He also demonstrated that administration of bovine GH to lactating dairy cattle enhanced milk production and productive efficiency (milk produced/unit of food consumed) of milk production (Harrelll *et al.*, 1996; Etherton, 2000). Much has happened since the early studies of PST and bovine GH by Larry. Approximately one-third of the dairy herds in the United States (about 3000 cows) is supplemented with recombinantly derived bovine GH in a sustained-release formulation that is administered every 14 d to lactating cows to improve milk production and efficiency of milk production. PST has impressive effects on growth. The extent to which this occurs is illustrated by studies in which maximally effective doses of PST (≈100 µg/kg of body weight per day) have been administered to growing pigs (for 30 to 77 d). These studies have demonstrated that growth rate is increased approximately 10% to 20%, feed efficiency (feed consumed/body weight gain) is improved 13% to33%, and protein deposition (muscle growth) is increased by as much as 62%.

Despite these findings, little is known about the exact metabolic pathways of PST liposome that mediate the effects on the adipose tissue lipogenisis. Further studies need to be conducted to precisely define how long the sustained-release effect can hold and maybe it can be taken orally one day.

CONCLUSION

Table I. Seven days later, female and male rat's daily gain

Item	Primary weight g		7th day g		7days gain g		Enhanced weight %	
	Female	Male	Female	Male	Female	Male	Female	Male
Control group	137.67±1.09	167.33±3.62	151.77±2.14	201.17±3.44	14.10±1.65	33.84±1.08	12.36[a]±1.19	20.22[c]±1.02
Group 1	139.5±2.77	165±4.17	163.51±3.00	209.68±4.20	4.01±1.85	44.68±3.86	17.21[b]±1.53	27.08[d]±2.61
Group 2	140.5±5.87	164.83±2.18	164.93±7.31	208.49±3.09	24.43±2.26	43.66±3.10	17.39[b]±1.42	26.49[d]±2.10
Group 3	140.4±3.81	165±4.33	164.1±3.69	208.68±5.53	23.7±1.27	43.68±2.38	16.88b±5.61	26.47d±1.39

A and b represent remarkable differences ($P<0.05$)

Table II. Fourteen days later female and male rats' daily gain

Item	Primary weight/g		14th day/g		14 days gain/g		Enhanced weight %	
	Female	Male	Female	Male	Female	Male	Female	Male
Control group	137.67±1.09	167.33±3.62	176.5±1.98	266.5±4.35	38.83±1.59	99.17±1.96	28.21[e]±1.00	59.27[g]±1.62
Group 1	139.5±2.77	165±4.17	202.17±1.20	279±6.87	62.67±1.74	114±5.33	44.92[f]±2.03	69.09[h]±2.92
Group 2	140.5±5.87	164.83±2.18	204±6.93	277.67±4.03	63.5±2.62	112.84±2.28	45.20[f]±2.20	68.46[h]±1.09
Group 3	140.4±3.81	165±4.33	181.67±4.96	264.33±6.86	41.27±5.00	99.33±2.97	29.39[e]±4.90	60.20[g]±1.83

Table III. Twenty eight days later females and males daily gain

Item	Primary weight/g		28th day /g		28days gain/g		Enhanced weight%	
	Female	Male	Female	Male	Female	Male	Female	Male
Control group	137.67±1.09	167.33±3.62	218.83±5.02	337.57±5.44	81.16±5.82	170.24±3.13	59.24[j0]±4.50	101.74[k]±2.44
Group 1	139.5±2.77	165±4.17	236.83±1.89	345.5±8.41	97.33±3.04	180.5±4.63	69.77[j]±3.51	109.34[l]±0.93
Group 2	140.5±5.87	164.83±2.18	236.33±7.78	347.46±7.03	95.83±3.13	182.63±5.52	68.21[j]±2.51	110.80[l]±2.89
Group 3	140.4±3.81	165±4.33	223.33±3.86	332.67±9.47	82.93±2.48	167.67±6.84	59.07[i]±3.54	101.62[k]±3.58

The results demonstrate that pure PST and PST liposome have the activity of promoting growth on female and male rats. The treatment groups show remarkable differences ($P<0.05$) relative to control group. PST liposome behaved itself with fine sustained-release effects that can last more than 7 days.

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