THE ABILITY OF COMMON CARP *CYPRINUS CARPIO* TO DIGEST DIFFERENT CARBOHYDRATE SOURCES

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(Received 5 January 2009, Accepted 15 April 2009)
Key words: common carp, carbohydrate, disaccharides .

ABSTRACT

Oral carbohydrate administration tests were used to gain more insight into the ability of common carp *Cyprinus Carpio* to digest different sources of carbohydrates. Four carbohyd- rates were administered orally after the common carp were fasted for 24h. Blood was sampled from fish at selected time intervals from 1 to 4h**.** Higher blood glucose level($p<0.05$) was found in fish fed on maltose**.** Fish fed the diet containing cellulose showed a lower glucose level**.** The blood glucose level of common carp peaked at 1h (373gm/dL for maltose **;**81gm/dLfor celluose)and at 3h(214gm/dL for lactose**;**184gm/dL for agar)after the oral admin- istration of carbohydrate**.** The maximum blood glucose level of 373 mg/dL observed at1h period following the maltose administration was significantly different from the maximum level observed at the same period following the cellulose administration.The maximum blood glucose level of 214 mg/dL observed at 3h period following lactose administration was significantly different from the maximum level observed at same period following the agar administration. Oral maltose resulted in apersistent hyperglycemia indicative of a diabetic-like status. Lactose appeared to be poorly absorbed from the intestinal tract and did not appear to be converted into glucose and galactose.These observations are consistent with the hypothesis that certain fishes, including the *Cyprinus Carpio*, resemble diabetic animals by having insufficient insulin for maximum carbohydrate utilization.

INTRODUCTION

Carbohydrates are the least expensive form of dietary energy for humans and domestic animals,but utilization by fish varies and is lower than that of domestic animals[1].Poor utilization of highly soluble carbohydrates by some animals usually results in abnormal signs that are considered indicators of carbohydrates intolerance[2].There are two types of carbohydrates intolerance;one results from the intestinal malabsorption of specific carbohyd- rates**;**the other from the animals inability to regulate the concentration of the absorbed carbohydrates in the blood[3].

Abnormal signs resulting from intestinal malabsorption of lactose, maltose and sucrose in humans[3],chicks [4] and cats [5] include diarrhea and gaseous acidic stool . Abnormal signs

resulting from the inability to regulate the plasma glucose concentration in humans and rats include elevated blood glucose,free fatty acids and ketone bodies, which lead to glycosuria ,ketosis, acidosis and dehydration[2,3]. No similar signs have been reported in fish except elevated levels of blood sugar. The Common carp *Cyprinus Carpio* is a wide spread freshwater fish related to the common gold fish Carassius auratus, with which it is capable of interbreeding[6]. It gives its name to the carp family Cyprinidae. It can grow to a maximum length1.5 meters and a maximum weight37.3 kg[7]. The Common carps differ from the other species of fish in their ability to digest different carbohydrates[8]. Common carp,Red sea bream,Nile tilapia,Yellow tail,Channel catfish and hybird tilapia grew better when fed a starch than a glucose diet[9]. In contrast,white sturgeon were found to have a greater ability for glucose utilization than for starch utilization[10]. Oral carbohydrate administration tests have been used to study the reason why some fish utilize carbohydrate poorly. The objective of the present study isto use these tests to further investigate the ability of common carp to digest different carbohydrates and determine the duration of fast needed for the blood glucose to reach a basal concentration arbitrarily set between 70.2 to 75.6 mg/dL.

MATERIALS AND METHODS

A total of 24 samples of *Cyprinus carpio*(6 samples for each group)with average weight 17.90g were fasted for 24h before the carbohydrate administrations. Each of the carbohydrate was administered orally.During the oral administration,the common carp was turned ventral-side up in the water and restrained by hand without anesthesia for less than 30 sec. Fish were not fed after the oral administration. Blood was sampled from caudal vein with a 22-gauge needle from fish at each of the pre-selected intervals and the fish were not reused after their blood was sampled. These procedures were all applied according to the methods used by Furuichi and Yone[11]and all data were subjected to statistical analysis according to the procedure reported by[12].

RESULT AND DISCUSSION

The weight gain of common carp fed different carbohydrate source is given in Table 1. The effects of oral administration of equivalent amounts of maltose, lactose, cellulose and agar on blood glucose levels are presented in Table 2, Figure 1and 2 .Blood glucose level of common carp after a 24h fast is about 181 mg/dL.The oral administration of lactose resulted in an increase in the blood glucose to a maximum' level at 3h of 214 mg/dL, followed by a decrease to 138 mg/dL 4 h after administration. The oral administration of agar resulted in a similar blood glucose profile as that observed with lactose.The initial increase in blood glucose was more gradual apparently

indicating a delay in absorption due to lactose being hydroliyzed to glucose and galactose and agar being hydroliyzed to galactose[13].

The maximum blood glucose level of 214 mg/dL observed at the 3h period following lactose administration was significantly different from the maximum level observed at the same period following agar administration.

On the other hand, the oral administration of maltose resulted in an increase in blood glucose to about 373 mg/dL at the 1h period, followed by a gradual decrease in blood glucose to reach 156 mg/dL at the 4h periods which may indcate that carp has much greater maltase activity in the pancreatic guice [14]. The oral administration of cellulose resulted in a similar blood glucose profile as that observed with maltose which may indicate that cellulose was the best utilization carbohydrates and the efficient utilization of this carbohydrate resulted from the activity of cellulase of bacterial origin that is present in the gut of most species of carps and probably a high cellulose uptake in the common carp intestine [15].The maximum blood glucose level of 373 mg/dL observed at the 1h period following maltose administration was significantly different from the maximum level observed at the same period following cellulose administration.

This is the first study of uptake of disaccharides and polysaccharides after the oral administration of maltose,lactose,cellulose and agar in fish .Oral carbohydrate administration tests have been used to study carbohydrate utilization in several species of fish including channel catfish [16], brook trout, blueback trout [15], rainbow trout [17],common carp, red sea bream and yellowtail [18].No time curve or control group was included in the previous studies [16, 17, 18] and blood was sampled for only 5 to 6 h, with the exception of the trout study [15], in which blood was collected for 36h.

Table (1): Percentage body weight of common carp fed on different carbohydrates source

Carbohydrate source	Growth rate%
Maltose	26.42±12.61
Lactose	21.70±7.35
Celluose	15.95±2.73
Agar	7.69±24.27

Means of three replicate groups±SD

Table (2): Blood sugar levels of common carp at various time intervals following oral administration of maltose, lactose, cellulose and agar (mg/dL).

Time h	Carbohydrate source

	Maltose	Lactose	Celluose	Agar
1	373	164	81	106
2	246	188	69	153
3	207	214	56	184
4	156	138	62	147

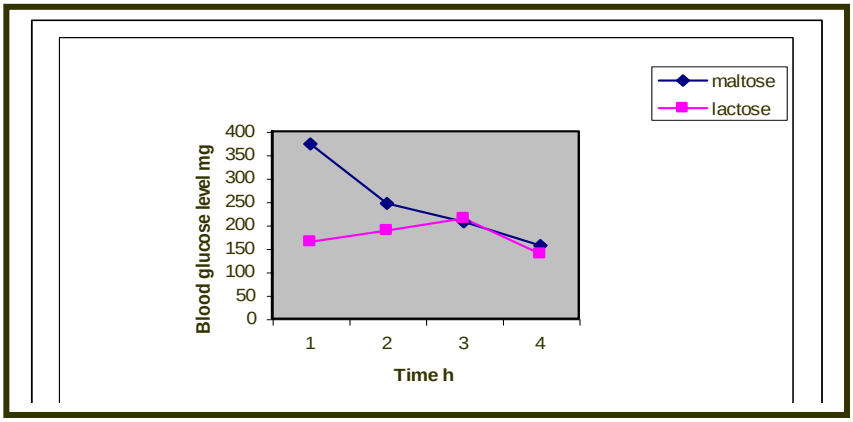

Figure 1: Blood glucose level in common carp fed on disaccharide. Each point represents the mean of three fish. 'Significantly (P < 0.05) affected by the time after carbohydrate feeding .

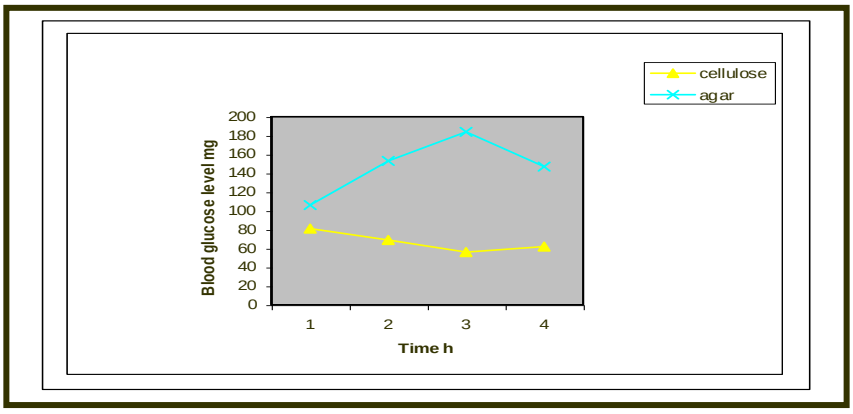

Figure 2: Blood glucose level in common carp fed on polysaccharide. Each point represents the mean of three fish. 'Significantly (P < 0.05) affected by the time after carbohydrate feeding.

قابليه سمك الكارب الاعتيادي على هضم الكاربوهيدرات من مصادر مختلفه

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الخلاصة

اختبرت اربع انواع من الكاربوهيدرات من عده مصادر في تغذيه لسمك الكارب عن طريق الفم بعد ان تم قطع الغذاء عن السمك مده 24 ساعه ، تم اخذ عينات من دم السمك بعد كل ساعه ،ساعتين ،ثلاث واربع ساعات . اعلى نسبه سكر في الدم تم تواجدها في السمك المغذى على المالتوز ، في حين السمك المغذى على السليلوز اظهر اقل نسبه سكر للدم. اظهر سمك الكارب المغذى على المالتوز والمغذى على السليلوز اعلى نسبه سكر للدم في الساعه الاولى (373 مالتوز ، 81 سليلوز) في حين اظهر سمك الكارب المغذى على اللاكتوز والمغذى على الاكار اعلى نسبه سكر للدم في الساعه الثالثه (214 مالتوز ، 184 اكار) . كان هناك فرق معنوي بين اعلى نسبه سكر للدم للسمك المغذى على المالتوز مع السمك المغذى على السليلوز عند نفس الفتره ومابين السمك المغذى على اللاكتوز مع السمك المغذى على الاكار

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