Yet these homofermentative lactobacilli which fermented readily at least 2 or, in some cases, all 3 pentoses showed no growth stimulation in the presence of the pentoses and some of them were inhibited.

An increase in the amount of glucose in the medium to equal the percent of glucose plus pentose did not alter the result: *L. fermenti* cultures in increased glucose were not stimulated as were the same cultures when supplied the pentoses and a smaller amount of glucose. The stimulation evidently is not simply a matter of an increased amount of fermentable sugar. When glucose was omitted from the medium, leaving the 3 pentoses, most of the lactobacilli failed to grow while a few grew very slowly. Autoclaving of the 3 pentoses along with glucose in the semisynthetic medium, instead of separate sterilization and later addition of the pentoses, did not decrease their stimulatory effect for *L. fermenti;* on the contrary, it seemed to augment it in some cases. No detailed study was made of the effect of individual pentoses on *L. fermenti.* A few tests showed that the growth acceleration produced by single pentoses differed somewhat from one strain to another, somewhat in the manner noted by Camien and Dunn(1).

Summary. Growth of the heterofermentative *Lactobacillus fermenti* (9 strains) was stimulated by a mixture of 3 pentoses: L-arabinose, D-xylose, and D-ribose when added to glucose-containing media. The pentose stimulation was observed in two different media but was more evident in a semisynthetic medium than in a medium containing yeast extract (APT medium). In contrast, no such stimulation was observed with any homofermentative lactobacilli classed as *L. casei, L. plantarum,* and *L. acidophilus.* Some of these cultures were slightly inhibited by the pentoses. Two heterofermentative lactobacilli from discolored meat products differed from *L. fermenti;* their growth was not appreciably affected by the pentoses.

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Distribution of Radioactivity in Human Maternal and Fetal Tissues Following Administration of C^{14}-4-Progesterone.* (23131)

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During human pregnancy, the plasma concentration of progesterone is very low and does not parallel the rapid increase of its urinary metabolites(1). This observation raised some doubt as to whether pregnanediol and pregnanolone excreted into the urine during pregnancy are actually the metabolic products of progesterone. On the other hand, it could be explained by the assumption that progesterone disappears quite rapidly from blood circulation in pregnancy. The latter explanation seemed to be more likely since Klein and Ober(2) were not able to increase plasma concentration of progesterone (as determined by the Hooker-Forbes test) in plasma of pregnant women by intramuscular administration of very large doses of progesterone (1000 to 1200 mg), although urinary pregnanediol is excreted in relatively large amounts following such an injection.

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Our own studies(3) revealed that after intramuscular administration of C^{14}-4-progesterone during 11th and 17th week of pregnancy plasma concentration of radioactivity rose sharply to a peak value within 24 hours and declined more slowly thereafter over 9 to 12 days. The peak concentration of radioactivity in plasma was relatively low, whereas large amounts of radioactivity appeared in urine at the same time. The concentration curve in plasma closely resembled that found for urinary samples obtained at frequent intervals after injection of the tagged hormone. In view of this parallelism and the observation of Klein and Ober it appeared proper to assume that the rise in concentration of radioactivity in plasma was due to an increase in concentration of metabolites rather than to the hormone. Substantial amounts of radioactivity derived from injected C^{14}-4-progesterone are eliminated by the feces(3) after having been secreted into the gastrointestinal tract by way of the bile. However, prompt excretion of inactivation products of progesterone into urine and feces does not fully explain the fact that large intramuscular doses of progesterone do not raise plasma level of the hormone during pregnancy. Intravenous administration of progesterone is followed by a rapid decline of plasma concentration within 2 hours(4). No progesterone could be detected in the plasma 24 hours after intravenous injection(5) although pregnanediol is excreted over a period of several days(4,6). There is no fundamental difference in excretion patterns of pregnanediol in the urine after intramuscular or intravenous injections or progesterone, indicating that absorption of the hormone from an oily intramuscular depot must be a fast and efficient process.‡

The following experiments were undertaken to study the possibility that progesterone absorbed from an oily depot in the muscle diffuses rapidly into the tissues. In the experiments reported here, the distribution of radioactivity in maternal and fetal tissues removed at various time intervals following intramuscular injection of C^{14}-4-progesterone, was determined.

Methods. C^{14}-4-progesterone prepared by the method of Thompson *et al.*(8), and purified by chromatography on alumina, was administered intramuscularly to 3 pregnant patients. Therapeutic abortions were performed at various time intervals after the injections. Maternal and fetal tissues obtained at surgery were combusted to carbon dioxide in a vacuum combustion line and counted in an ionization chamber, using a vibrating reed electrometer according to the method of Brownell and Lockhart(9). All measurements were done for periods long enough to give a standard error of less than ± 5%.

Results. Patient C.C. This patient (gravida III, para II) was 37 years old and had a severe bronchial asthma which required almost constant medical care. Seven months before she became pregnant she had hyperthyroidism. Treatment with I^{131} and propylthiouracil resulted in a good therapeutic response, but it did not have a favorable effect upon the asthmatic condition. The patient was 11 weeks pregnant when 28.1 μc of C^{14}-4-progesterone were injected intramuscularly 48 hours before a therapeutic abortion was performed. The distribution of radioactivity found in maternal and fetal tissue is reported in Table I. The results are ex-

TABLE I. Radioactivity in Maternal and Fetal Tissue.

Dose of C^{14}-4-progesterone, 28 μc (intramusc.). 48 hr interval between inj. and therapeutic abortion. 11 wk of pregnancy.

Tissues	Wt, g	μc/g × 10^{-6}	μc/ organ × 10^{-6}	% of administered radioactivity in organ
Maternal				
Corpus luteum	3.67	153	562	.00200
Rest of ovary	2.58	45	116	.00041
Decidua		170		
Myometrium		368		
Fat		845		19.6 *
Skin		72		
Fetal				
Placenta	46.	52	2392	.00854
Liver	.62	26	16	.00005
Lungs	.25	10	3	.00001
Heart	.12	14	2	.000007
Intestine	.46	11	5	.00002
Brain	1.85	0		—

* Calculated from total body wt of patient.

‡ This is likewise true for estrogens since there is no difference between daily amounts of radioactivity excreted into urine after intramuscular and intravenous injection of C^{14}-labelled estrogens(7).

TABLE II. Radioactivity in Maternal and Fetal Tissue.
Dose of C^{14}-4-progesterone, 12 μc (intramusc.). 24 hr interval between inj. and therapeutic abortion. 17 wk of pregnancy.

Tissues	Wt, g	μc/g $\times 10^{-6}$	μc/ organ $\times 10^{-6}$	% of administered radioactivity in organ
Maternal				
Corpus luteum	2.45	71	175	.00146
Rest of ovary	4.60	18	83	.00069
Decidua		62		
Myometrium	531 *	41	21771	.18142
Fat		368		33.7 †
Skin		85		
Fetal				
Placenta	120	74	8880	.07400
Liver	8.25	0	—	
Adrenals	.70	61	43	.00036
Testes	.20	0		
Lungs	3.70	35	128	.00107
Heart	.65	18	12	.00010
Brain	12.00	0		

* Total wt of emptied uterus.
† Calculated from total body wt of patient.

pressed in μc/g of tissue. Table I also gives percentage of administered dose of radioactivity found in various organs. The myometrium, decidua and corpus luteum had relatively high concentrations of radioactivity whereas moderate amounts were detected in the rest of the ovary, maternal skin and fetal placenta. Relatively small amounts of radioactivity derived from labelled progesterone were found in all fetal tissues with the exception of the brain where no radioactivity was detected by the method used. However, by far the highest concentration of radioactivity was present in a sample of maternal fat obtained from subcutaneous tissue of abdominal wall. Assuming that 18% of total body weight of this patient consisted of fat, approximately 19.6% of the administered dose of radioactivity was present in the fat compartment 48 hours after administration of the tagged hormone provided that radioactivity was evenly distributed in the fat.

Patient J.O. This patient (gravida VIII, para V) was 37 years old and had a huge goiter for many years which enlarged quite rapidly during a 5-month period preceding date of admission to hospital. At that time she was 11 weeks pregnant. There were no symptoms of thyrotoxicosis. Growth of the goiter continued during the following weeks and the pregnancy was terminated during the 17th week because of possible carcinoma of the thyroid. The patient received 12 μc of C^{14}-4-progesterone intramuscularly 24 hours before surgery. The values of radioactivity found in the various tissues are shown in Table II. Again, the highest concentration of radioactivity was detected in a sample of maternal fat. Only moderate amounts of radioactivity were present in the myometrium, decidua, corpus luteum, maternal skin and fetal placenta. Concentration of radioactivity in fetal organs was lower than that found in maternal tissues. No radioactivity could be detected in the fetal liver, testes and brain. A relatively high concentration of activity was present in fetal adrenals when compared with that found in other fetal organs.

Patient M.P. This patient (gravida II, para 0) was 27 years old and had lupus erythematosus. The patient's condition became progressively worse during the first half of pregnancy and a therapeutic abortion was performed during the 18th week of gestation. This patient died of her diseases 6 weeks after pregnancy termination. She received 15.5 μc of C^{14}-4-progesterone intramuscularly 12 hours before the hysterotomy was performed. As shown in Table III, considerable amounts

TABLE III. Radioactivity in Maternal and Fetal Tissue.
Dose of C^{14}-4-progesterone, 15.5 μc (intramusc.). 12 hr interval between inj. and therapeutic abortion. 18 wk of pregnancy.

Tissues	Wt, g	μc/g $\times 10^{-6}$	μc/ organ $\times 10^{-6}$	% of administered radioactivity in organ
Maternal				
Corpus luteum	1.10	55	61	.00039
Decidua		46		
Myometrium	490 *	89	43610	.28135
Fat		228		17.7 †
Skin		168		
Fetal				
Placenta	111	115	12765	.08235
Liver	5.39	41	221	.00143
Adrenals	0.54	112	61	.00039
Lungs	5.51	14	77	.00050
Heart	1.02	7	7	.00004
Brain	18.4	0		—

* Wt of emptied uterus.
† Calculated from total body wt of patient.

of radioactivity were found in maternal fat and skin obtained from the abdominal wall during the operation. Comparatively small amounts of activity were present in the myometrium, decidua, and corpus luteum. The largest amounts of radioactivity in the fetal organs were found in the placenta and adrenals, whereas no activity could be detected in the fetal brain.

Discussion. Following intramuscular administration of C^{14}-4-progesterone to 3 pregnant patients the highest concentration of radioactivity was found in maternal fatty tissue. Assuming an even distribution of radioactivity in the fat of the body, about 17.7%, 33.7%, and 19.6% of the administered dose were present 12, 24, and 48 hours, respectively after administration of the labelled hormone. These calculations are based on the assumption that 18% of total body weight of the patients consisted of fat.

These findings indicate that progesterone and/or its metabolites diffuse promptly from the blood circulation into the fat of the body when this steroid hormone is administered intramuscularly. We have not determined whether the radioactivity found in fat was derived from the hormone or from its metabolites. However, it appears very likely that the radioactivity is principally due to the presence of unchanged hormone since Kaufmann and Zander(10) found relatively high concentrations of progesterone in fatty tissues of pregnant women which were 6 times greater than that found in fat of non-pregnant women during the luteal phase of the menstrual cycle.

Our results explain the following observations: (1) failure of large doses of progesterone injected intramuscularly to raise blood level of progesterone and rapid disappearance of progesterone from blood after intravenous injection; (2) delayed excretion of progesterone metabolites after intravenous injection; (3) the previous observation(3,11) that specific activity of urinary C^{14}-pregnanediol derived from injected C^{14}-acetate declined during a 48 to 72 hour period after removal of principal sources of the hormone, the placenta and the corpus luteum. We explained this phenomenon previously as a dilution of the radioactive pregnanediol with inert steroid molecules derived from the maternal adrenals. In view of our findings it is more likely that the urinary C^{14}-pregnanediol was diluted by molecules derived from progesterone stored in maternal fat.

It further demonstrates that erroneous conclusions may be drawn from the values obtained for urinary pregnanediol in regard to progesterone production. Pregnanediol may continue to be excreted into the urine in appreciable amounts although production of the hormone has already ceased, a fact which has been recently demonstrated in one of our patients who was in spontaneous labor(3,11).

It is of interest to note that only moderate amounts of radioactivity derived from tagged progesterone were found in the myometrium and the decidua in 2 patients with advanced pregnancy (17th and 18th week of gestation), whereas a relatively higher concentration was found for both tissues in a patient who was 11 weeks pregnant. The decidua as well as the myometrium are considered to be the most important target organs for progestational activity. In mice and rats a low level of radioactivity derived from C^{14}-21-progesterone was found in the uterus(12). Progesterone could not be isolated from the myometrium and the decidua of pregnant women when a very sensitive method of chemical assay was used(13). At present, we have no knowledge about the actual mechanism by which a hormone exerts its biological effect on the target organ.

Low to moderate concentrations of radioactivity derived from C^{14}-4-progesterone were found in the corpus luteum and the placenta. This is logical for these endocrine glands are unfavorable sites for absorption and storage of the hormone which they elaborate.

Radioactivity was found in all fetal tissues in relatively small amounts with exception of the brain (negative radio-assay in all 3 cases), the testes (negative assay in one case) and the liver (negative assay in one of 2 cases). The comparatively highest concentration of radioactivity in fetal organs was found in the adrenal glands of 2 fetuses 17 and 18 weeks old. Progesterone is regarded as an important intermediate of adrenal cortical steroids. However, only small amounts of corticoids

can be detected in fetal adrenal glands at this stage of embryonic life. On the other hand, the relatively high concentration of progesterone may be due to accumulation of lipids in the fetal cortex. However, histochemical studies indicate that lipoid material is present in only relatively small amounts in the fetal cortex, but these amounts may be still higher than that found in other fetal organs. In view of this finding it is of interest that Riegel *et al.*(12) found a relatively high concentration of radioactivity in the adrenals of mice after administration of C^{11}-21-progesterone.

Summary. C^{14}-4-progesterone was administered intramuscularly to pregnant women who were scheduled for therapeutic abortion. Distribution of radioactivity in maternal and fetal tissue removed at various time intervals following injections was determined. The highest concentration of radioactivity was found in the maternal fat. A rough calculation revealed that it contained about 17.7% of the administered radioactivity 12 hours, 33.7% 24 hours, and 19.6% 48 hours after administration of the labelled hormone. These findings indicate that progesterone and/or its metabolites diffuse promptly from the blood circulation into the fat compartment of the body. Only moderate amounts of radioactivity were found in the myometrium and the decidua, the 2 principal target organs of progesterone. Low to moderate concentrations of radioactivity were detected in the organs which serve as principal sources of the hormone, the corpus luteum and the placenta. Radioactivity was present in all fetal tissues in relatively small amounts with the exception of the fetal brain, and the testes.

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Assay and Some Properties of Kidney Transamidinase.* (23132)

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Transamidination in mammalian kidney slices and homogenates was first reported by Borsook and Dubnoff(1). The reaction has since been confirmed by other investigators with the use of isotopic technics(2-5).

This paper reports a simple assay for tissue transamidinase activity. The assay was used to determine the following effects: addition of sulfhydryl inhibitors both *in vivo* and *in vitro*, substitution of canavanine for arginine as one of the substrates, *in vitro*, and substitution of a protein-free diet for a complete diet in the rat.

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