

# Nutritional Intervention throughout Gestation Alters Growth, Body Composition and Organic Phenomenon Patterns in Striated Muscle

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## Abstract

Variations in maternal nutrition during gestation can influence foetal growth, foetal development and permanently 'programme' offspring for postnatal life. The objective of this study was to analyse the effect of increased maternal nutrition during different gestation time windows on offspring growth, carcass quality, meat quality and gene expression in skeletal muscle. A total of 64 sows were assigned to the following feeding treatments: a standard control diet at a feed allocation of 2.3 kg/day throughout gestation increased feed allowance of 4.6 kg/day from 25 to 50 days of gestation (dg), from 50 to 80 dg and from 25 to 80 dg. At weaning, Light, Medium and Heavy pigs of the same gender, within litter, were selected based on birth weights, individually penned and monitored until slaughter at 130 days post weaning. Carcass and meat quality traits of the semimembranosus (SM) muscle were recorded post mortem. A cross section of the semitendinosus (ST) muscle encompassing the deep and superficial regions were harvested from pigs (n = 18 per treatment) for RNA extraction and quantification of gene expression by real-time PCR. The results showed that doubling the feed intake from 25 to 50 dg reduced offspring growth, carcass weight, intramuscular fat content and increased drip loss of the SM muscle. Interestingly, protein phosphatase 3 catalytic subunit –  $\alpha$ -isoform, which codes for the transcription factor calcineurin, was up regulated in the ST muscle of offspring whose mothers received increased feed allowance from 25 to 50 dg. This may provide an explanation for the previous observed increases in Type IIa muscle fibres of these offspring. Increasing the maternal feed intake from 50 to 80 dg negatively impacted pig growth and carcass weight, but produced leaner male pigs. Extending the increased maternal feed intake from 25 to 80 dg had no effect on offspring over the standard control gestation diet. Although intra-litter variation in pig weight is a problem for pig producers, increased maternal feeding offered no improvement throughout life to the lighter birth weight littermates in our study. Indeed, increased maternal nutrition at the three-gestation time windows selected provided no major benefits to the offspring.

**Keywords:** Sow; Nutrition; Gestation; Meat; Quality

## Introduction

Prenatal programming is information or insults that produce lasting physiological responses at key levels of prenatal development. Maternal nutrition during pregnancy is one of the sources of information that influences fetal growth and development, with potentially lifelong consequences. The muscle fibers, their number, and their composition per unit area are the keys to the yield and quality of meat. Parturition programming is relevant to the pork business. This is because hyperbolic feeding affects muscle fibers at key stages of intrauterine development. Occurs and it is reasonable to note that secondary fibers form units. Apparently, the amount of muscle fibers is determined at birth. Studies have shown that increasing sow maternal diets from 25-50 m unit weights to 45-80 m unit weights improves fiber range, size ratio between secondary and primary fiber types, and ox oblique affects the composition of fiber type IIa progeny, usually with favourable improvements downstream. However, several studies have found that hyperbolic maternal nutrition does nothing, or probably has no adverse effect on offspring growth. An increase in the number of stillborn piglets with hyperbolic feeding to 80 BW was observed. A true omnivore, pigs exhibit dietary patterns, physiology of biological processes, and eating habits similar to humans [1]. As a result, the study of gestational feeding in pigs and its effect on fetal development, body composition and growth patterns provides a model for understanding humans influencing health risks later in life. The underlying mechanism of the intrauterine programming domain unit is thought to be a nutritional response that castrates the maternal and fetal endocrine axis. Nutrients can travel directly with genes and their regulatory elements at the cellular level, incapacitating growth patterns and organic phenomena. Therefore, examining the transcription levels

of genes associated with skeletal muscle regulation, metabolism, and chemical pathways may help elucidate the biological mechanisms of specific constitutions. Insulin-like protein I (IGF1) is a highly endocrine 70 organic compound with well-established effects on postnatal growth and development. PAX7, expressed from satellite cells, encodes a transcriptional paired box domain-7 that regulates proliferation/differentiation into mature cells in muscle. MYOG encodes myogenin, a fundamental helix-loop-helix transcriptional problem involved in cell formation. Encrypted Calcineurin [2].

## Materials and Method

The experiment had a 2-by-two factorial design: two dietary treatments of the mothers and, per mother treatment, 2 dietary treatments of the offspring. The aim was to attain an identical and a mismatching treatment within the offspring cluster as compared to the treatment within the mother cluster. The experimental protocols were approved by the Animal Use and Care Committee of Wageningen University, European nation.

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Received: 01-Aug-2022, Manuscript No: JPMS-22-72439, Editor assigned: 03-Aug-2022, PreQC No: jpms-22-72439 (PQ), Reviewed: 17-Aug-2022, QC No: JPMS-22-72439, Revised: 22-Aug-2022, Manuscript No: JPMS-22-72439, Published: 27-Aug-2022, DOI: 10.4172/jpms.1000188

Citation: Melanie S (2022) Nutritional Intervention throughout Gestation Alters Growth, Body Composition and Organic Phenomenon Patterns in Striated Muscle. J Paediatr Med Sur 6: 188.

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## Hens

In total 480 60-week-old hens of a purebred line of broilers (Cobb Europe) were appointed to 1 of 2 feeding strategies: additional (A) or less (R) than their original diet. The food contained 16 PF crude super molecule (CP) and four.1% crude fat, associated had an energy worth of eleven.41 MJ/kg. The feeding methods were applied for five weeks: four weeks before conception, to assure that the fertilised eggs all had developed throughout maternal food restriction or abundance, and one week when conception to gather the eggs for brooding. The aim was to possess associate as giant as attainable distinction in feed intake between each teams of hens whereas ensuring that the extra fed hens still managed to eat all their feed, and also the restricted hens continued to get and failed to begin to melt. To attain this distinction, a stepwise approach was chosen. During the primary a pair of weeks, the distinction in feed intake was restricted to twenty-eight (i.e. 156 g/day v. 112 g/day). Eggs were collected and hold on a day to day for seven days [3-4].

## Eggs

A total of 828 eggs of the ad libitum-fed hens and 702 of the restricted hens were collected and, when seven days of egg collection and storage, placed within the apparatus at 1500 h. The eggs were incubated at associate covering temperature of thirty seven.88C and a ratio of roughly five hundredth. The covering temperature was recorded on one egg within the centre of every apparatus receptacle by attaching a semiconductor unit with heat-conducting paste (Schaffner Holding Ag, Luterbach, Switzerland) and lined with regular sellotape (Lourens et al., 2005). On day nineteen of incubation, the eggs were candled and non-fertilized eggs were removed. The remaining eggs were transferred to hatching crates for every hen treatment severally. These were place during a single acclimatized space at 378C and hour wetness. the primary check for hatched chicks was on day twenty, 1500 h, then at 2300 h, 700 h on day twenty one, and at 1500 h the last chicks were hatched. the primary 624 chicks that hatched and appeared healthy were appointed to the experiment. The sex of the chicks wasn't determined at hatch [5].

## Chicks

During the checks for hatched chicks, the chicks that were appointed to the experiment were weighed, their navel was scored one (completely closed), a pair of (0 to a pair of metric linear unit, gap remaining) or three (.2 mm, gap remaining), bearing on what extent the navel was closed, and also the chicks were labelled through the neck skin victimization Swiftacks with a novel ID variety to permit individual recognition. When tagging, the chicks were collected and transferred to their pens. As per the feeding strategy of the hens, chicks were at random allotted to their pens, that were stuffed (13 chicks) before the chicks were allotted to successive pen. Therefore, at intervals the pen, the chicks were largely of a similar age. The sex of the chicks wasn't determined at this stage [6].

## Housing

The chicks were housed in four climate controlled stalls, every containing twelve floor pens of one three one.8 m, four drinking nipples and one feeding trough, and from week a pair of onward, 2 feeding troughs to permit enough feeding area. Lightweight the sunshine} regime was sixteen h light and eight h dark. Excelsior was used as covering. Wet stains were removed and extra contemporary shavings were provided. Every pen housed thirteen chicks. Just in case of mortality, the chicks weren't replaced. Every of the four treatments

was portrayed thrice in every stall, and pen treatments were alternated during a fastened order. Initially, the tem-perature associated wetness were regulated per an avail-able theme, and later adjusted downward per chick behaviour [7].

## Treatments

The chicks were fed ad lib till one day in the end chicks had hatched. Within the evening of day one, the food was aloof from the restricted pens. Then, for every feeding level of their mothers, the chicks were fed either ad lib or restricted to seventieth of ad lib for a amount of six weeks. A similar batch feed was used for the length of the experiment.

## Discussion

The results of this study in broilers indicate that offspring of mothers that were restricted in their food intake before and around conception may grow to a lower adult weight than chicks of ad libitum mothers. This becomes especially apparent in the restricted chicks where in week 6, even though they were on the same diet, males of ad libitum mothers grew significantly faster than males of restricted mothers. In addition, in the ad libitum chicks, in week 6 males of ad libitum mothers grew faster than those of restricted mothers. Such division in growth trajectory between the offspring of ad libitum v. restricted mothers seems to point toward a pre-programmed future difference in adult size due to a change in statue and/or muscle mass. In this study, there seems to be no difference in skeletal development, measured by tarsus length. There is, however, a change in BW most likely due to a change in muscle mass. Muscle is the largest organ in the body and is heavier than fat because of the water fraction. It is also an energy-demanding organ. A smaller muscle mass would therefore substantially increase metabolic efficiency and would allow a larger proportion of the expect-edly poor resources to be allocated to other functions such as reproductive effort. Indeed, maternal food restriction before conception results in a reduction in the number of myosin type 2 fibers in sheep, and in the muscle mass later in life in sheep, humans, rats, and pigs. In contrast, the ad libitum maternal environment may have provided a cue to develop to a heavier adult weight. For males (and possibly for females), being heavier would have a competitive advance- tag and as the environment is expected to be rich, increased maintenance costs are not an issue [8]. Even though muscle development was not measured in this study, these results in mammals suggest that the difference in growth in the males of ad libitum and restricted mothers in week 6 is due to a difference in muscle development. This would imply that chicks with a mismatched rich maternal-poor offspring nutritional environment would be at a disadvantage. The chicks in this study were slaughtered prematurely and there- fore fitness could not be determined, but the results of comparable studies in mice suggest that this will indeed be the case. Ad libitum female chicks of restricted, but not ad libitum, mothers grew faster in week 3, and ad libitum male chicks of restricted mothers in week 4, though not significantly. This accelerated growth in off-spring of restricted mothers in a rich nutritional environment has also been observed in mammals. One reason for this accelerated growth could be that the ad libitum off- spring of restricted mothers are 'programmed' to grow according to the expected poor food availability [9].

## Conclusion

Nutritionally evoked in-utero growth restriction followed by accelerated postpartum growth ends up in inflated aerobic and nitrosamine stress, accelerated end shortening, altered polymer repair and inhibitor defence capability, additionally to inflated

cellular senescence and programmed cell death in hearts of adult offspring. These area units all indicative of a premature viscous aging composition. CoQ10 supplementation of the offspring postpartum diet corrected the viscous cellular stress; end shortening, inhibitor defence alterations, and cellular senescence and programmed cell death, thereby protective against premature vessel aging (please see Graphical Abstract). a very important next step are going to be to determine if alternative suboptimal in utero exposures, like foetal drive result in the same constitution outcome in reference to accelerated viscous aging. Such info can give insight on whether or not CoQ10 supplementation doubtless is probably going} to represent a wide applicable intervention strategy that's likely to forestall the inflated risk of upset ensuing from associate degree array of various in utero insults. These findings would have necessary implications for translatable therapies targeted towards at-risk human populations [10].

### Acknowledgement

The assistance of Mairead Daly, Edward Beatty, Philippa Fealy and Claire choreographer is appreciatively acknowledged. we have a tendency to convey the workers of the Pig Development Unit for care and feeding of the animals employed in this study. This analysis was funded by the Teagasc, below the National Development set up. McNamara, Giblin, Markham, Stickland, Berry, O'Reilly, Lynch, Kerry and Lawler. Louise McNamara was in receipt of a Teagasc Walsh Fellowship funding for the period of her PhD. we have a tendency to appreciatively acknowledge funding from COST925 below the Short Term Scientific Mission (STSM) fund that enabled Louise McNamara trip the RVC.

### Conflict of Interest

The authors wish to declare that there are no conflict of interest associated with this manuscript.

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