47 - BENEFITS OF NITRIC OXIDE ON MUSCULAR HYPERTROPHY

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INTRODUCTION

The exercises of resistance training are, indeed, one of the most studied physical activities in these days (Gentil,2005). Bodybuilding has become more and more popular, not only among athletes, but also among sportsmen and people in general, due to the increasing scientific foundation of this activity (Bossi, 2001).

According to Guedes, 1997, "bodybuilding is a method of sportsmanship training". In high performance sports, the athletes look after bodybuilding methods aiming at developing several types of power needed for their own modalities. In the scope of fitness academies, bodybuilding has become a very important modality, either for enhancing bodily aesthetics and performance or just for health and quality of life purposes.

The subject of alimentary supplementation is a rather old one. Since a long time ago one has been looking after elixirs able to act on our organism, beyond the sole effect of normal alimentation. After several experiments with many alimentary supplements on athletes and bodybuilding practitioners, it appeared one of them - the nitric oxide (NO) - which was shown to be able to promote muscular hypertrophy, through permanent hemodilation.

In 1980, Furchgott and Zawakzki demonstrated that the vascular relaxation induced by acetylcholine was dependent on the presence of endothelium and evidenced that such an effect was mediated by a labile humor factor, later known as endothelium dependent relaxation factor (EDRF). In 1987, it was demonstrated that this EDRF was nothing more but a free radical, that is, the nitric oxide (NO).

The present study aimed at verifying the muscular hypertrophy levels in individuals who were given nitric oxide supplements, compared to others which used amino acid and a control group which did not receive any supplement at all, yet all three groups were submitted to the same power training program.

MATERIALS AND METHODS

The model of analysis adopted in this study was of the type experimental (THOMAS & NELSON, 2002). Six volunteer individuals participated in the study, three of them being male and three female, all of them being seemingly healthy and having been practicing weight training for more than a year. The sample selection was done intentionally, that is, based on their availability and convenience for the control group. Despite its small size, the sample was very heterogeneous regarding age, ethnicity or bodily composition. The ages ranged from 20 to 30 years and the bodily mass showed a difference which varied from 63.90 kg to 87.20 kg, mainly in the male group. All subjects can be classified as significantly active.

The investigation was divided into three steps: (1) Pre-test, (2) Training Program and (3) Post-test. For each step, one has used the following material:

•Steps 1 and 3 (Pre-test and Post-test/Physical Evaluation):

One scale, label Filizola; one estadiometer, label Cardiomed; one adipometer (skinfold caliper), label Cescorff and one metric tape, label Sanny.

•Step 2 (Training Program):

•Group I (females): Stretching chair; free crouching support with bar and washers, horizontal leg; unilateral strechting chair; flexing chair, leg 45º.

•Group II (males): Scott bench; Bar support with bar and washers; Dumbell crossover.

INTERVENTION

The exercises were performed three times a week, with intermission and maximum duration of 30 minutes.

Physical evaluation was initially performed with all six participants, at the "academia Corpore", in the city of João Pessoa, PB, in March 2006. During this phase the body mass was measured with a 100 grams resolution scale, label Filizola. The subjects were not wearing shoes nor heavy dressing, but shorts and bikinis. Following, it was verified the stature of all the participants, using a estadiometer, label Cardiomed. In order to determine the percentage of body fat, the corporeal mass was evaluated using an adipometer, label Cescorff. The perimeter was gauged using a metric tape, label Sanny. The protocol used was that of Pollock for seven cutaneous folds, that is: sub-scapular, super-iliac, abdominal, tri-occipital, medial thigh, medial axillaries and toraxic. All the gauging was done by a Physical Education professional, whose specialization was physical evaluation.

As a result of the physical evaluation, it was observed that the participants did not have any counter-indication regarding maximum load test performing, supplementation and hypertrophy training.

MAXIMUM LOAD TEST (1-RM)

All subjects were submitted to two 1-RM sessions, during the Leg Press exercises for the women and Direct Thread of biceps and triceps-forehead for the men, with 48 hours intervals between sessions, for muscular strength evaluation.

The 1-RM test was conducted according to the protocol suggested by Baechle; Groves (1992). Aiming at reducing the margin of error during the 1-RM test, one adopted the following strategies: standardized instructions established before performing the tests, in such a way that the examinee was conscious of the whole routine involving the data acquisition phase; pre-instructions given to the examinees concerning the techniques of movements execution; gauging of all the weights and bars with a calibrated scale; for each resting minute, elongations were done on the most specific muscle chosen for the repetition test, following the recommendations of the American College of Sports Medicine - ACSM (ACSM, 2000).

SUPPLEMENTATION

Each group was prescribed a supplementation for each individual, that is, one of them ingested NO, another one ingested amino acid and the last one did not ingest any alimentary supplement at all. Those who used NO took two tablets before training and two before going to bed; those who used amino acid had a similar schedule, that is, two tablets before training and two before going to bed. The supplemental diet supply coincided with the training duration.

RESULTS

The following tables were classified following the results of 1-RM tests, corporeal mass and weight of each individual.

TABLE 1
DESCRIPTIVE DATA FOR 1-RM TEST - LEG 45º (WOMEN) AT THE BEGINNING AND AFTER 30 DAYS

Examinee	Before	After	Results (gain)
A	160 Kg	200 Kg	?40 Kg
B	180 Kg	260 Kg	?80 Kg
C	230 Kg	260 Kg	?30 Kg

A = subject using amino acid; B = subject using NO; C = subject not using any supplementation at all

TABLE 2
DESCRIPTIVE DATA FOR COMPARATION OF CORPOREAL MASS (WOMEN) AT THE BEGINNING AND AFTER 30 DAYS

Examinee	Before	After	Results (gain)
A	51,20 Kg	52,30 Kg	?1,10 Kg
B	58,90 Kg	60,20 Kg	?1,30 Kg
C	59,80 Kg	60,30 Kg	?0,50 Kg

A = subject using amino acid; B = subject using NO; C = subject not using any supplementation at all

TABLE 3
DESCRIPTIVE DATA FOR COMPARATION OF PERCENTAGE OF FAT (WOMEN) AT THE BEGINNING AND AFTER 30 DAYS

Examinee	Before	After	Results (gain)
A	19,98 %	19,62 %	?0,33 %
B	28,50 %	26,12 %	?2,38 %
C	27,59 %	26,75 %	?0,84 %

A = subject using amino acid; B = subject using NO; C = subject not using any supplementation at all

TABLE 4
DESCRIPTIVE DATA FOR 1-RM TEST - DIRECT THREAD (MEN) AT THE BEGINNING AND AFTER 30 DAYS

Examinee	Before	After	Results (gain)
X	32 Kg	36 Kg	?4 Kg
Y	54 Kg	56 Kg	?2 Kg
Z	36 Kg	38 Kg	?2 Kg

X = subject using amino acid; Y = subject using NO; Z = subject not using any supplementation at all

TABLE 5
DESCRIPTIVE DATA FOR 1-RM TEST - TRICEPS FOREHEAD (MEN) AT THE BEGINNING AND AFTER 30 DAYS

Examinee	Before	After	Results (gain)
X	24 Kg	22 Kg	?2 Kg

TABLE 6
DESCRIPTIVE DATA FOR COMPARATION OF CORPOREAL MASS (MEN) AT THE BEGINNING AND AFTER 30 DAYS

Examinee	Before	After	Results (gain)
X	70,0 Kg	69,60 Kg	?0,4 Kg
Y	87,20 Kg	89,40 Kg	?2,2 Kg
Z	63,90 Kg	63,80 Kg	?0,1 Kg

X = subject using amino acid; Y = subject using NO; Z = subject not using any supplementation at all

TABLE 7
DESCRIPTIVE DATA FOR COMPARATION OF PERCENTAGE OF FAT (MEN) AT THE BEGINNING AND AFTER 30 DAYS

Examinee	Before	After	Results (gain)
X	18,84 %	15,91 %	?2,93 %
Y	18,06 %	16,61 %	?1,99 %
Z	16,88 %	12,41 %	?4,47 %

X = subject using amino acid; Y = subject using NO; Z = subject not using any supplementation at all

DISCUSSION

In this work one observed that the forced training associated with a nitric oxide supplementation has promoted greater gains of power and muscular hypertrophy, as compared to subjects that did not receive any supplementation at all. One observed a gain of muscular mass and power, as well as a reduction in the fat percentage, among the female group. However, the subject who used nitric oxide supplementation showed the best results.

Regarding the male group, there was a gain of power in all the subjects, concerning the biceps test. However, the subject who ingested amino acid supplement showed unsatisfactory results with respect to the triceps test. As far as the gains in corporeal mass are concerned, the subject who ingested amino acid supplement showed unsatisfactory results, while the other two obtained positive results. Considering the percentage of fat, all subjects obtained a reduction.

Smith and Criswell (2002), proposed, in their study, the necessity of nitric oxide supplementation for promoting hypertrophy in rats. Kingwell (2000) showed that NO is important for metabolism regulation during the exercise. Gailly and

Mrechal (1999), in their studies related to the effects of nitric oxide on contraction of skeletal muscle, obtained positive results as the effect of increasing metabolism and muscular contractility is concerned. Smith *et. al*. (2002), in a study with rats to investigate the role of nitric oxide synthase (NOS), through surgical removal of the muscles soleus and gastrocnemius, proved there has been a hypertrophy in the cross section area (P<0.05), in all types of fibers in that group of muscles. Naokata *et. al*. (2005), investigating skeletal muscle hypertrophy in rats, through venous occlusion, demonstrated an increase in muscular weight (P<0.01), while using NOS. Gianetti *et. al*. (2002), showed there is a high capacity of inhaled nitric oxide in promoting pulmonary vascularization, in individuals with pulmonary hypertension or hypoxia, resulting in a better gaseous exchange and ventilation. Driscoll *et. al*. (2004) performed studies relating the effects of nitric oxide on the exercise, and confirmed an increase of vascularization of the endothelium. Anderson and Pollard (2000) showed the importance of nitric oxide in promoting muscular repair, through a complete recovery of fiber, within a minute after muscle rupture. The studies of Giraldez *et. al*. (1997) evidenced the cardio protecting role of NO in cardiac ischemia and reperfusion. Their studies aimed at determining the effects of ischemia and cardiac reperfusion on isolated hearts of rats, subjected to periods of global ischemia or ischemia plus cardiac reperfusion. The results were sufficiently significant, showing a 77% decrease in ischemia after a 60 minutes period, becoming almost undetectable after 120 minutes. Kuo *et al(1999)* realized studies on portopulmonary hypertension, and verified that nitric oxide (specific pulmonary vasodilator), when administered by inhalation, did not present clear results and suggested using NO in the pre surgical handling of patients candidate to hepatic transplantation. Jobe and Bancalari (2001), showed that NO is a powerful vasodilator, which has been used via inhalation during mechanical ventilation, in order to reduce pulmonary shunt and inflammation. They used low doses of NO premature new-born with pulmonary hypertension, aiming at preventing bronco pulmonary dysplasy, but their results were inconclusive

CONCLUSION

Based on the positive results obtained, the present study suggests a supplementation of NO in order to optimize the gains of muscular mass and power, through physical training with weights. Furthermore, another important observation was a reduction of fat percentage in both groups, taking into account that the objective of this study was to investigate only the gains in corporeal mass and power.

The results relating gains of power in the male group did not reflect the expectation that the best outcome would be manifest by the individual who used NO supplementation.

Taking for granted the relevance and actuality of the subject in the ambit of academies and sporting middle, the alimentary supplementation is still a sufficiently controversial issue.

In conclusion, taking into account the shortage of studies relating NO as a fundamental element in promoting muscular hypertrophy, it would be advisable to implement new researches on this subject.

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BENEFITS OF NITRIC OXIDE IN THE MUSCULAR HYPERTROPHY

ABSTRACT

The objective of the present study was to verify the results concerning hypertrophy and muscular strength on individuals submitted to power training during four weeks, from which one group received amino acid supplement, another one received nitric oxide, whereas the last one did not receive any supplementation at all. Six individuals participated in the study, three of them being males and the other three being females. All of them were seemingly healthy and have been practicing weight training for more than a year. The subjects were randomly separated into two groups, three males and three females. Out of the three individuals of each group, one received a nitric oxide supplement, another received amino acid and the third one did not receive any supplement at all. Both groups were submitted to physical evaluation, which included measurements of body mass, height, percentage of body fat and perimeter. The proposed physical activity consisted in resistance training, divided in programs A and B, the exercises being performed three times a week for a whole month. However, prior to start the program, both groups

performed a maximum weight test, in order to assess the percentage of weight to be used in the training programs. The results showed there was a gain of power and muscle mass as well as a reduction of body fat in the female group, making evident the better results obtained with those individuals which received a nitric oxide supplementation. On the other hand, all the male subjects showed body fat reduction, but only those which did not receive any supplement at all failed to show any gain of power. Concerning gain of body mass, only that individual that received a nitric oxide supplementation did succeed.

This study showed, therefore, that, despite the small number of participants, there were significant percentage variations with respect to anthropometric parameters among the individuals, thus revealing that a nitric oxide supplementation was effective in increasing power and muscular hypertrophy.

Key words: hypertrophy, nitric oxide, power

BENEFÍCIOS FONT NA HIPERTROFIA DE ÓXIDO NÍTRICO MUSCULAIRE

ABSTRAIT

L'objectif de la présente étude était de vérifier les résultats tandis qu'hypertrophie et force musculaire dans les individus pour faire la formation de force pour quatre semaines, un un groupe recevant l'aminoacid, un oxyde nitrique différent et un groupe différent sans suppléments. Six individus ont participé à l'étude, à trois d'entre eux étant masculins et à trois d'entre eux femelle, à tous sains et à formation de pratique de weigth pendant plus d'une année. Les individus étaient aléatoires séparé dans deux groupes, un étant masculin et l'autre femelle. Hors des trois individus de chaque groupe, on a reçu le supplément nitrique d'oxyde, un autre aminoacid reçu et des autres non reçu n'importe quel supplément. Les groupes ont accompli l'évaluation physique dans laquelle a mesuré le poids corporel, la taille, le pourcentage de la graisse du corps et les mesures de circonférence. L'activité physique proposée était la formation de résistance divisée dans les programmes A et B, rentrent l'endroit trois fois par semaine pendant trente jours. Cependant, avant que l'essai ait commencé, un essai de poids maximum a été réalisé pour les les deux les groupes afin de définir le pourcentage du poids à employer dans la formation. Les résultats ont prouvé qu'il y avait un gain de la masse de force et de muscle et une réduction de graisse du corps du groupe féminin devenant évident qu'il y avait de meilleurs résultats dans les individus qui ont reçu le supplément nitrique d'oxyde. Par rapport au groupe masculin, tous de réduction obtenue de graisse du corps, mais seulement les individus qui pas supplément reçu n'ont pas gagné la force. Pour ce qui concerne la masse musculaire seulement l'individu qui a reçu le supplément nitrique d'oxyde a obtenu un gain. Cette étude a prouvé que dans juste le petit nombre de participants il y avait une variation de pourcentage significative pour les paramètres d'anthropometrics entre les individus une fois qui le supplément nitrique d'oxyde était efficace dans l'augmentation de la force et de l'hypertrophie musculaire.

Mots clés : hypertrophie, oxyde nitrique, force

BENEFÍCIOS HACEN NA HIPERTROFIA DE ÓXIDO NÍTRICO MUSCULAR

RESUMEN

El objetivo del actual estudio era verificar los resultados mientras que hipertrofia y fuerza muscular en individuos para hacer el entrenamiento de la fuerza para cuatro semanas, un grupo que recibía el aminoacid, otro óxido nítrico y otro grupo sin suplementos. Seis individuos participaron en el estudio, tres de ellos que eran masculinos y tres de ellos hembra, todos sanos y el entrenamiento practicante del weigth por más de un año. Los individuos eran aleatorios separado en dos grupos, el uno que era masculino y la otra hembra. Fuera de los tres individuos de cada grupo, uno recibió el suplemento nítrico del óxido, otro aminoacid recibido y otro no recibido cualquier suplemento. Los grupos terminaron la evaluación física en la cual midió el peso corporal, la altura, el porcentaje de las grasas de cuerpo y medidas de la circunferencia. La actividad física propuesta era el entrenamiento de la resistencia dividido en los programas A y B, admite el lugar tres veces por la semana por treinta días. Sin embargo, antes de que la prueba comenzara, una prueba del peso máximo fue realizada para ambos los grupos para definir el porcentaje del peso que se utilizará en el entrenamiento. Los resultados demostraron que había un aumento de la masa de la fuerza y del músculo y una reducción de las grasas de cuerpo en el grupo femenino que hacía evidente que había resultados mejores en los individuos que recibieron el suplemento nítrico del óxido. En lo referente al grupo masculino, todas de reducción obtenida de las grasas de cuerpo, sino solamente los individuos que no lo hicieron suplemento recibido no ganaron la fuerza. Referente a la masa muscular solamente el individuo que recibió el suplemento nítrico del óxido obtuvo un aumento. Este estudio demostró que en apenas el número pequeño de participantes había una variación de porcentaje significativa para los parámetros del anthropometrics entre los individuos una vez que el suplemento nítrico del óxido era eficiente en el aumento de la fuerza y de la hipertrofia muscular.

Palabras claves: hipertrofia, óxido nítrico, fuerza

BENEFÍCIOS DO ÓXIDO NÍTRICO NA HIPERTROFIA MUSCULAR

RESUMO

O objetivo do presente estudo foi verificar os resultados quanto à hipertrofia e força muscular em indivíduos submetidos a treinamento de força por 04 semanas, sendo um grupo recebendo aminoácido, outro óxido nítrico e outro grupo sem suplementação.

Participaram do estudo seis indivíduos, sendo três do sexo masculino e três do feminino, todos aparentemente saudáveis e praticantes de musculação há mais de um ano. Os indivíduos foram separados aleatoriamente em dois grupos, sendo um masculino e outro feminino. Dos três indivíduos de cada grupo, um recebeu suplementação de óxido nítrico, outro aminoácido e outro não recebeu suplementação. Os grupos realizaram avaliação física, na qual mensurou-se a massa corporal, a estatura, o percentual de gordura e a perimetria. A atividade física proposta foi o treinamento resistido dividido em programa A e B, sendo realizado três vezes por semana e durante 30 dias. Foi realizado o teste de carga máxima(1 RM) para ambos os grupos, para definir o percentual da carga a ser utilizado nos treinamentos.Os resultados mostraram que houve ganho de força e massa muscular e redução de gordural corporal no grupo feminino, obtendo melhores resultados nos indivíduos que receberam suplementação de óxido nítrico. Com relação ao grupo masculino, todos obtiveram redução na gordura corporal, não havendo, entretanto, ganho de força no indivíduo que não recebeu suplementação. Quanto à massa muscular, somente o indivíduo que recebeu suplementação com óxido nítrico obteve ganhos. Este estudo mostrou que, apesar do número reduzido de participantes, obteve-se diferenças significativas para os parâmetros antropométricos entre os indivíduos, uma vez que a suplementação com óxido nítrico foi eficaz no aumento da força e hipertrofia muscular.

Palavras-chave: hipertrofia, óxido nítrico, força