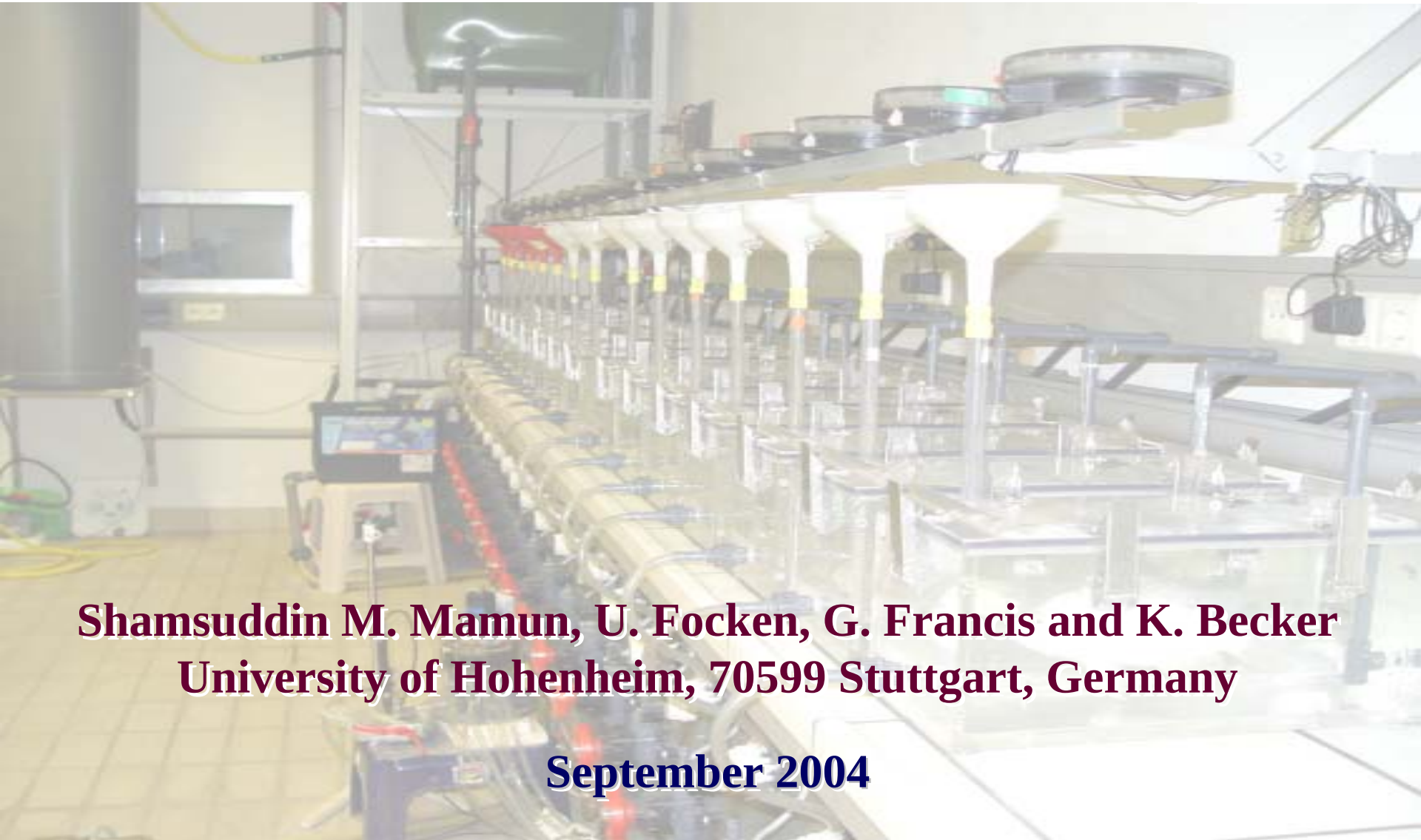
GROWTH PERFORMANCE AND METABOLIC RATES OF GENETICALLY IMPROVED AND CONVENTIONAL STRAINS OF NILE TILAPIA, *OREOCHROMIS NILOTICUS* (L.)



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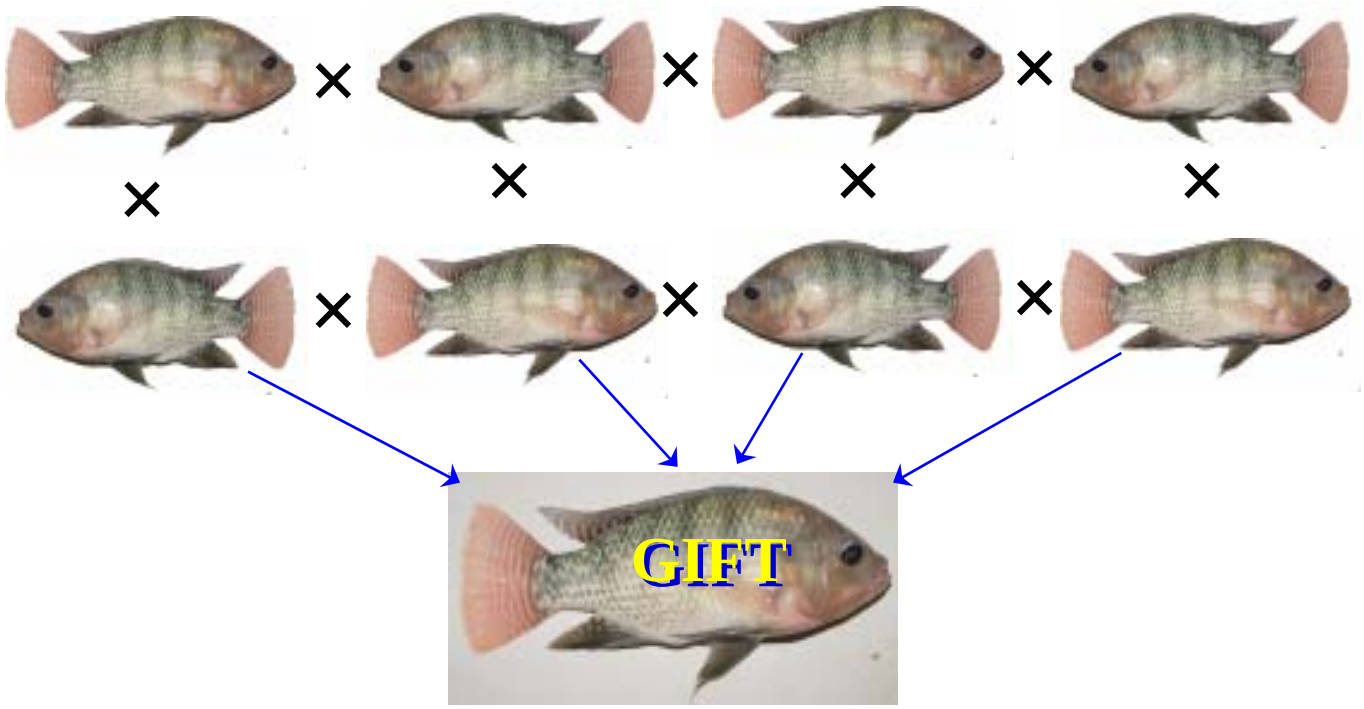
INTRODUCTION

Tilapia is a most promising protein source in near future

Africa ⇨

Philippines ⇨



Genetically Improved Farmed Tilapia

GIFT vs. CNT (Conventional Nile Tilapia)

Authors	System	Days	Strain	Conclusion
Circa et al. 1995	Rice-fish	90	GIFT, Is., Se.	All similar
Hussain et al. 2000	Pond	180	GIFT, CNT	GIFT: 57% better
Dey et al. 2000	-	-	GIFT, CNT	GIFT: better 18% (China) 58% (Bangladesh)
Nandlal et al. 2001	Pond	120	GIFT, CNT	GIFT: 25% better

Why is GIFT claimed to perform better?

Because of -

- **Higher feed intake**
- **Better utilization of feed nutrients**
- **Better feed conversion efficiency**
- **More aggressive behavior**
- **Higher metabolic performance**

OBJECTIVES OF PRESENT STUDY

Comparison of growth and metabolism of GIFT and CNT by determination of -

⇨ **Metabolic parameters:**

- **Standard metabolic rate (SMR)**
- **Routine metabolic rate (RMR)**
- **Active metabolic rate (AMR)**

⇨ **Growth parameters:**

- **Growth, growth rates and feed utilization efficiency**
- **Energy budget and energy utilization**
- **Organo-somatic indices**

⇨ **Behavioral parameter:**

- **Swimming activity of fish**

HYPOTHESIS

GIFT are claimed to have >50% better growth performance than CNT, therefore, there are differences

- **in metabolic rates (SMR, RMR)**
- **in growth potential**

MATERIALS AND METHODS

Experimental fish

Tilapia strain	Sex	Obtained from / when
GIFT-SR*	HTM	GenoMar ASA, Philippines December 2002
GIFT-NSR*	Mixed	
CNT-NSR	Mixed	University of Göttingen October 2002

*Ninth generation
(HTM: Hormone treated male)

Fish feed

Components and chemical composition

Basal composition of feed	
Ingredients	**%**
Fish meal	50
Wheat meal	42
Sunflower oil	4
Vitamin premix	2
Mineral premix	2

Proximate composition of feed	
Composition	**%**
Dry matter (% FM)	95.1
Crude protein (% DM)	41.0
Crude lipid (% DM)	9.0
Ash (% DM)	12.7
Gross energy (kJ/g DM)	19.9

FM = fresh matter, DM = dry matter

Experimental set up

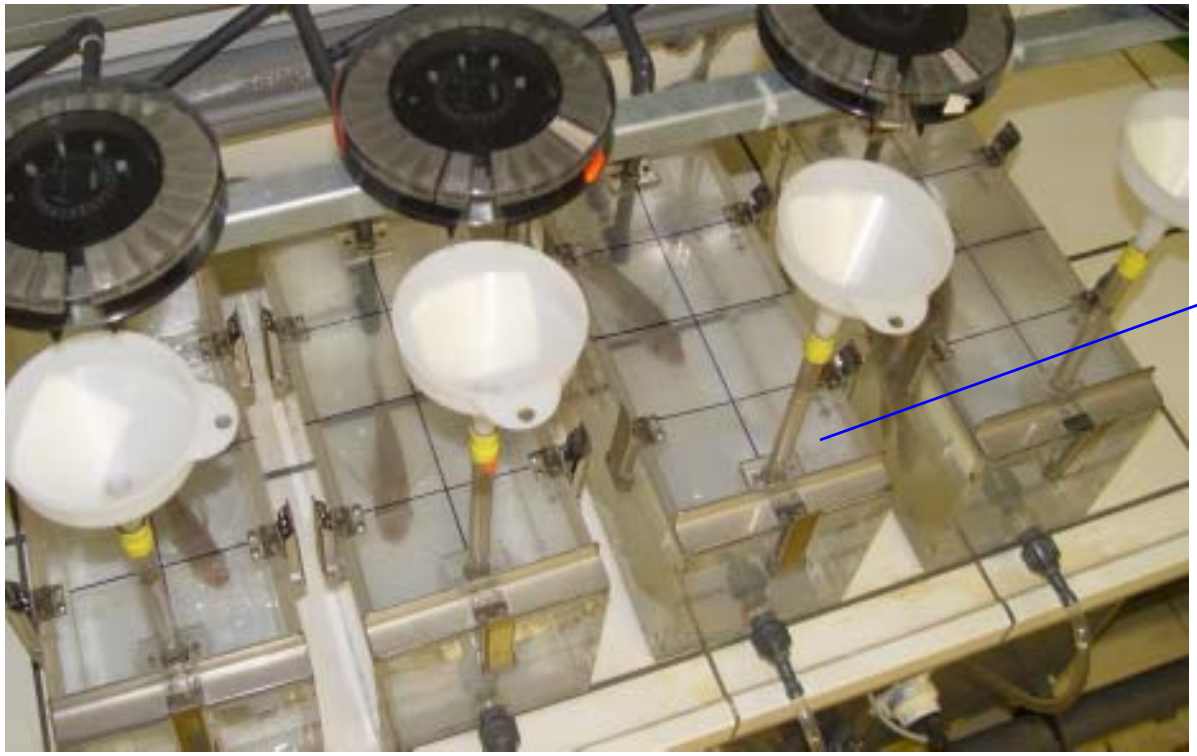
⇨ Recirculating respirometer system

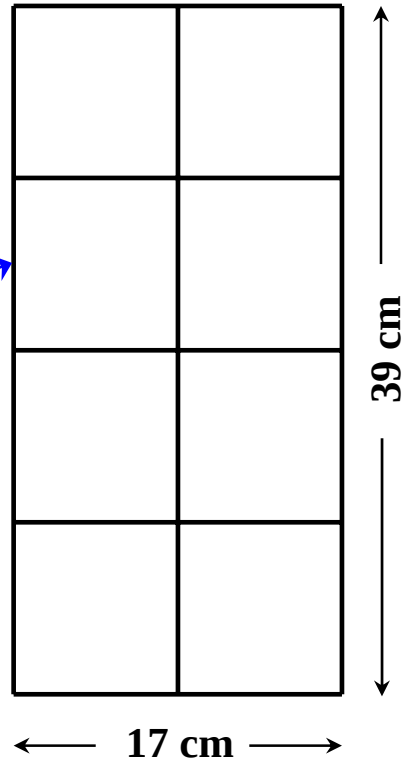
- 15 respirometer chambers
- Volume: 11.3 *l*
- Computer controlled
- Continuous O_2 measurement
- Automatic feeding

⇨ Conditions

- 5 fish of each strain
- Duration: 17 weeks
- Temperature: 27 ± 0.2 ^{O}C
- Dissolved O_2: 5.93 – 7.58 mg/*l*
- pH: 7.32 – 7.62
- Light: 12 h light / 12 h dark

Measurement of swimming activity

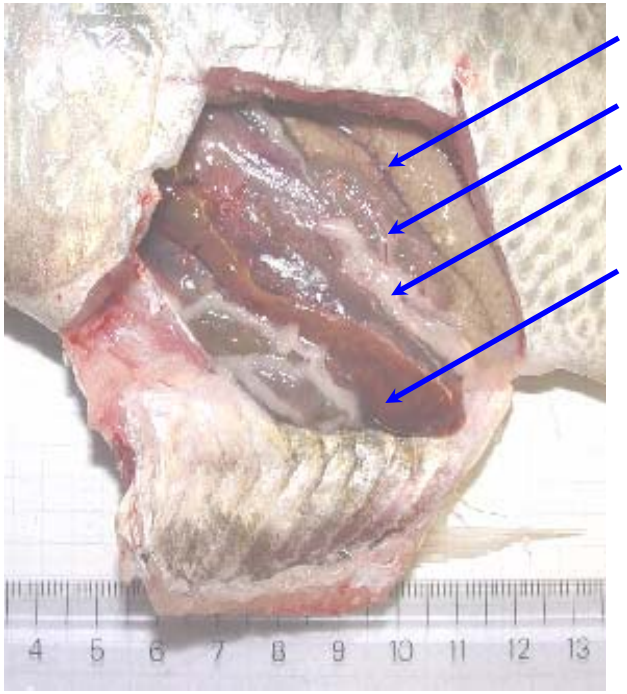


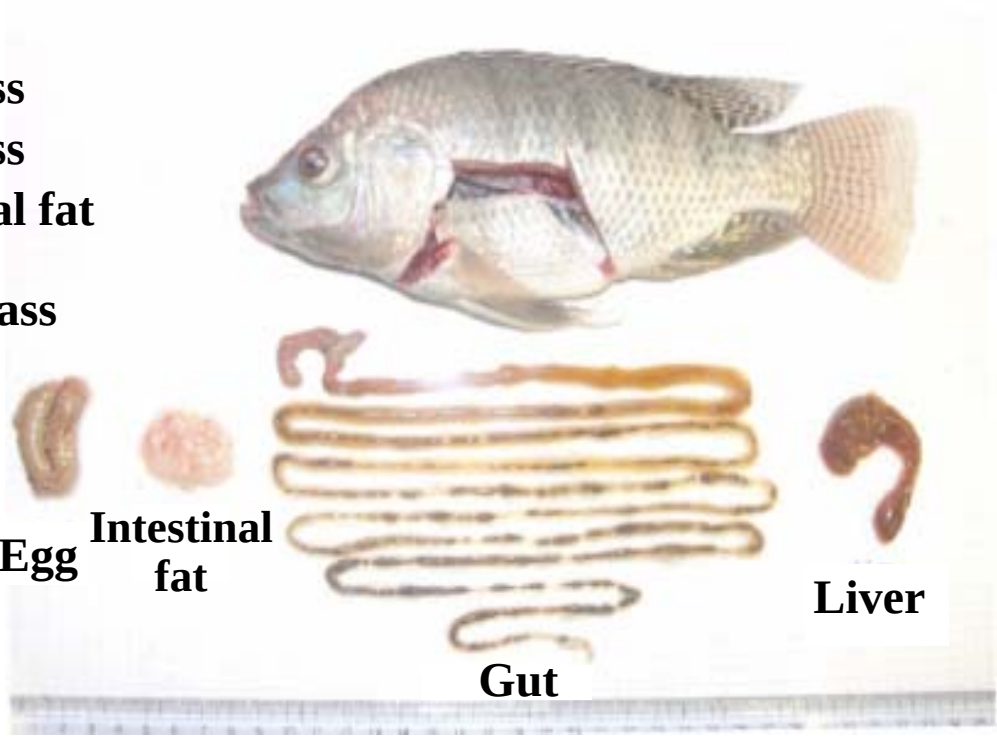


- Transparent plastic sheet with grid lines (8.5 cm × 9.75 cm)
- Observed from above for 15 min for each fish
- Twice a day at varying hours
- Twice a week

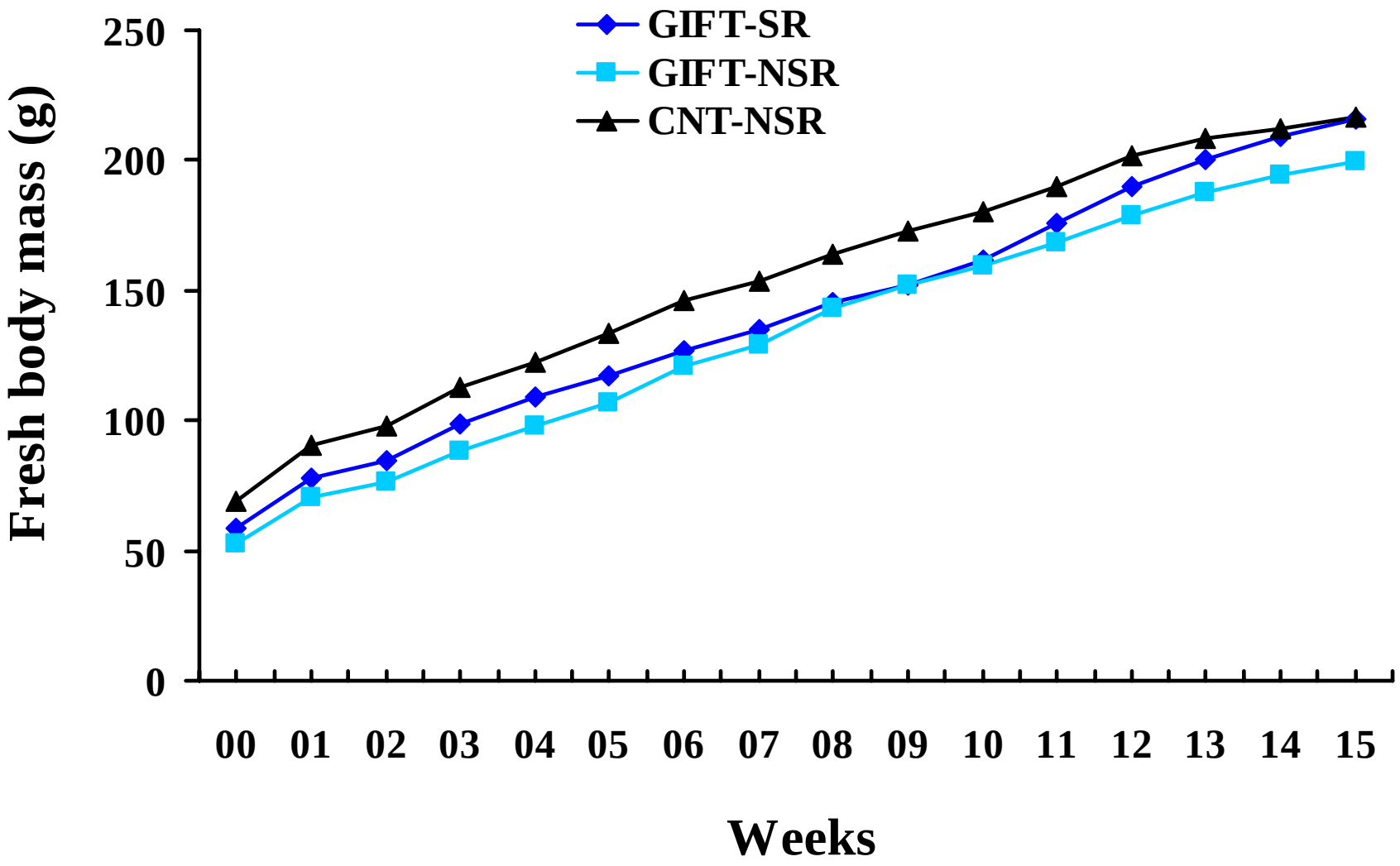
Dissection details

- **Fish were dissected for measuring the intestinal parameters:**





RESULTS: Body mass development



Body mass, growth rate and feed utilization efficiencies

Parameters	GIFT-SR	GIFT-NSR	CNT-NSR
Initial body mass (g)	58.8 ± 13.5	52.6 ± 32.5	68.7 ± 16.3
Final body mass (g)	215.7 ± 34.3	199.5 ± 66.9	216.5 ± 53.9
Metabolic growth rate ($g\ kg^{-0.8}\ d^{-1}$)	10.2 ± 2.8	11.0 ± 3.0	9.9 ± 2.7
Feed conversion efficiency (g gain / g feed DM)	0.8 ± 0.3	0.7 ± 0.3	0.6 ± 0.3

(n = 5, DM = dry matter)

Average metabolic rates (mg O_2 $kg^{-0.8}$ h^{-1})

Tilapia groups (n = 5)		GIFT-SR	GIFT-NSR	CNT-NSR
SMR	Initial	49 ± 13	48 ± 10	55 ± 5
	Final	91 ± 31	108 ± 36	85 ± 31
RMR (Av. 15 weeks)		148 ± 16	147 ± 15	154 ± 12

(mean ± standard deviation)

Protein and lipid utilization efficiency

Parameters	GIFT-SR	GIFT-NSR	CNT-NSR
Protein efficiency ratio	2.0 ± 0.2	1.8 ± 0.6	1.6 ± 0.1
Productive protein value (%)	38.3 ± 1.7	33.1 ± 10.2	30.0 ± 2.5
Apparent lipid conversion (%)	99.2 ± 9.5	79.9 ± 34.6	68.6 ± 10.5

(n = 5)

Energy utilization

Parameters	GIFT-SR	GIFT-NSR	CNT-NSR
Feed GEO (kJ)	3879 ± 715	4082 ± 1307	4425 ± 1013
Total energy expenditure* (kJ)	1194 ± 169	1135 ± 361	1326 ± 245
Energy expenditure (% GEO)	31.1 ± 3.3	28.5 ± 1.1	30.2 ± 2.0
Energy retention (% GEO)	36.7^{a} ± 2.0	30.7^{ab} ± 10.1	26.9^{b} ± 3.2
Apparent not metabolized energy (% GEO)	32.3^{b} ± 3.6	40.9^{ab} ± 10.3	42.8^{a} ± 4.0

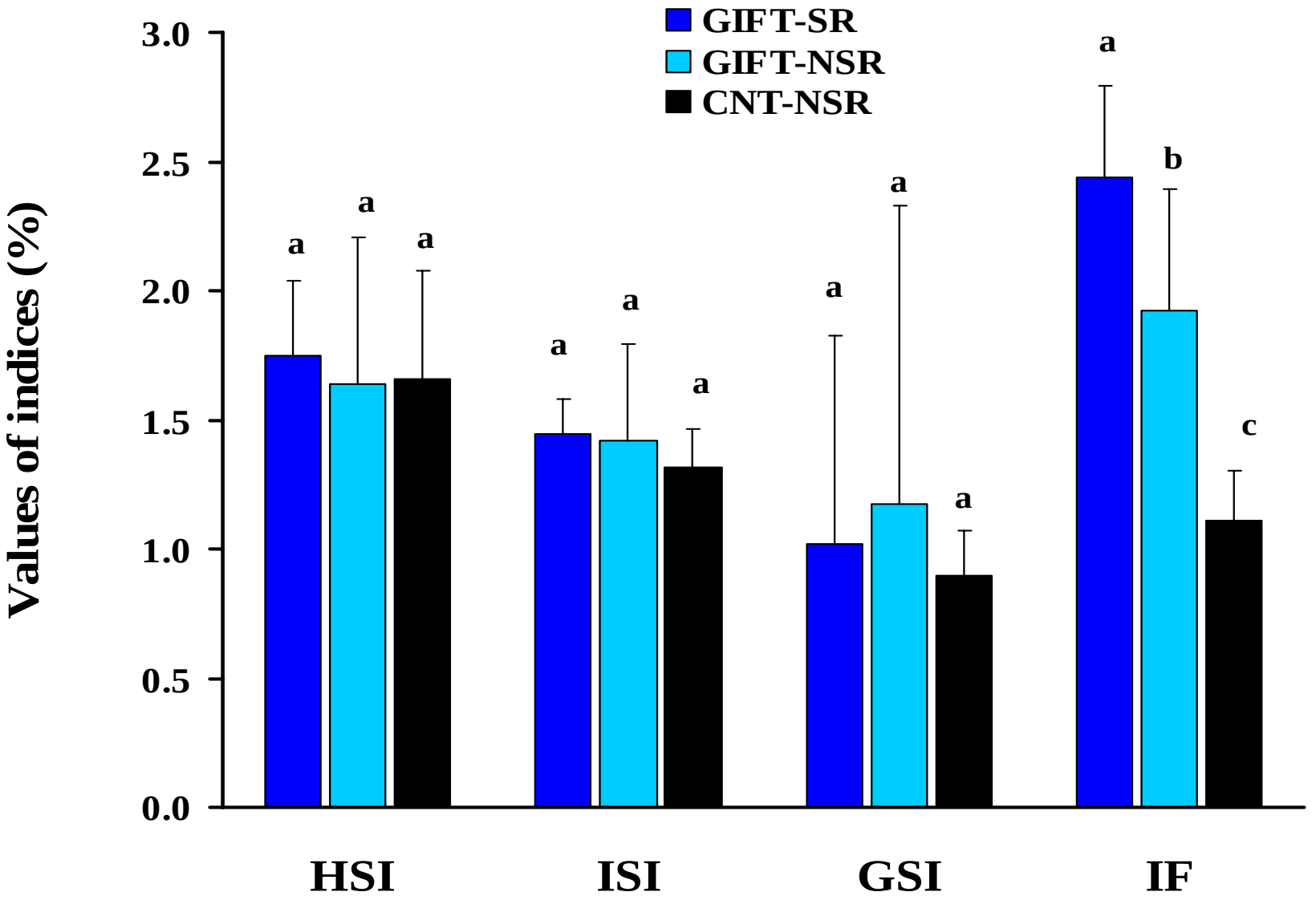
*Calculated from O_2 consumption
GEO = Gross energy offered
Significant at $p<0.05$

Initial and final proximate body composition

Proximate composition	Initial (n = 3)			Final (n = 5)		
Ingredients	GIFT -SR	GIFT -NSR	CNT-NSR	GIFT -SR	GIFT -NSR	CNT -NSR
Dry matter (DM, % of fresh matter)	20.1^{a}	24.5^{a}	24.9^{a}	32.3^{a}	32.2^{a}	31.3^{a}
Crude protein (% DM)	63.9^{a}	62.2^{a}	65.6^{a}	54.8^{a}	55.1^{a}	57.1^{a}
Crude lipid (% DM)	16.9^{a}	19.3^{a}	13.4^{a}	27.8^{a}	26.0^{ab}	23.6^{b}
Ash (% DM)	16.7^{b}	16.0^{b}	18.9^{a}	14.5^{b}	15.4^{ab}	16.2^{a}
Gross energy (kJ/g DM)	21.7^{a}	21.9^{a}	20.6^{a}	24.6^{a}	24.0^{ab}	23.4^{b}

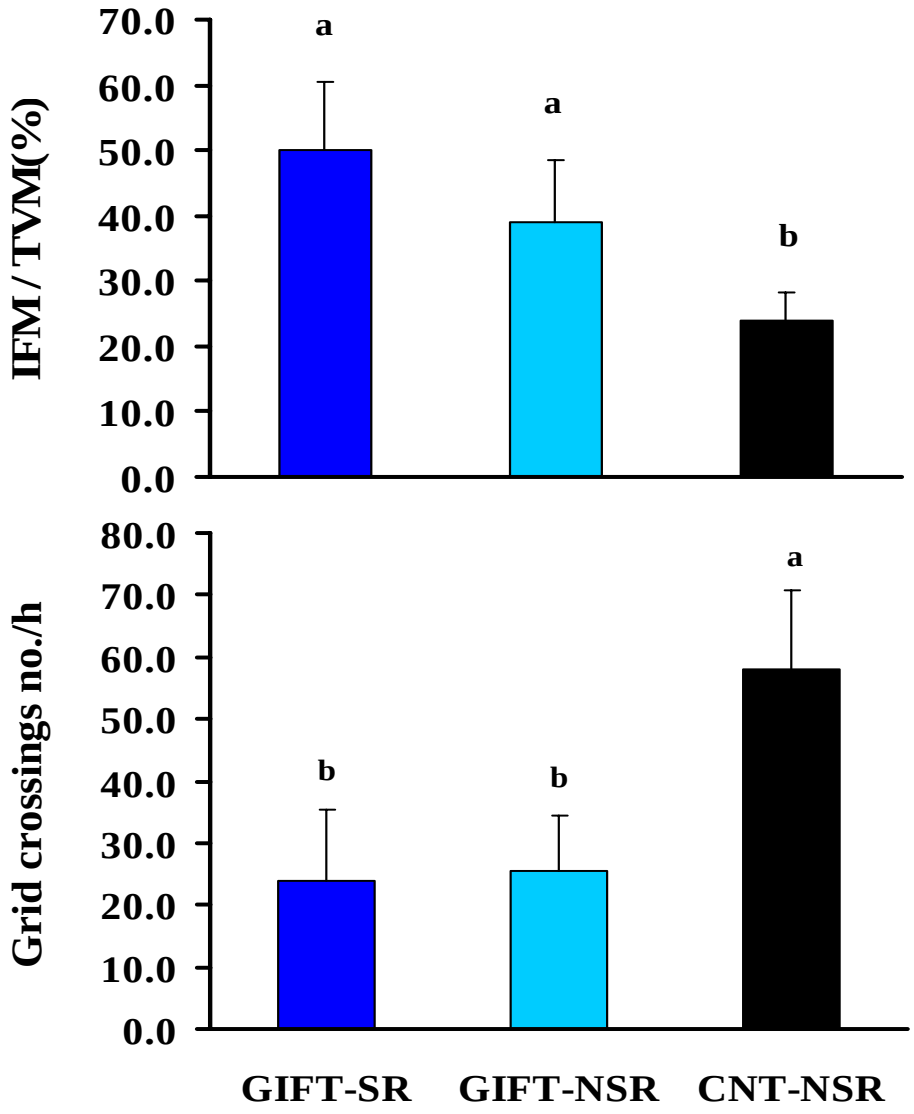
Significant at $p<0.05$

Organo-somatic indices and intestinal fat content



Significant at p<0.05

Intestinal fat mass (A) and swimming activity (B)



***Intestinal fat mass (IFM) / Total visceral mass (TVM)**
Significant at $p<0.05$

CONCLUSION

- **No significant differences were observed in growth performance and metabolic efficiency between the three Nile tilapia groups under standardized laboratory conditions**
- **No significant differences were observed in FCE and feed intake among the three groups**
- **No significant differences were observed in SMR and RMR among the three groups**
- **GIFT strains were less active and retained more energy in the form of deposited fat**
- **There is a major conflict between the farm feeding trials and laboratory experiments**

Further studies

Following behavioral studies may also help to resolve the conflicts between farm and laboratory experiment -

- **Competition for feed**
- **Reproduction**
- **Other behaviors**
  - **Territory protection**
  - **Male dominancy**
  - **Sexual influence**

None of these happen in our laboratory experiment !

Thank you

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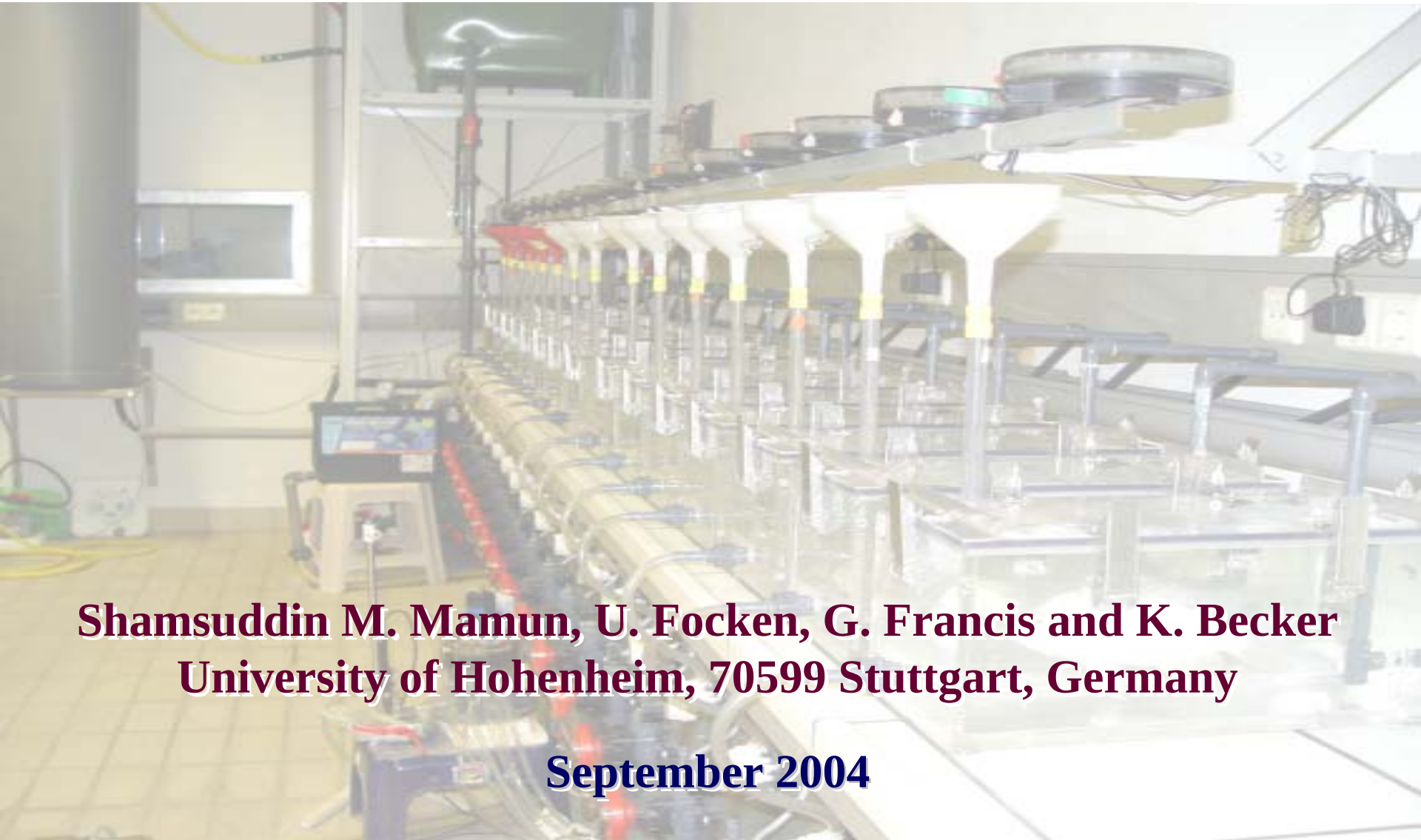

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Dear Readers,

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(NH_4+), nitrate (NO_3-) and nitrate (NO_2-) remained favorable for fishing during the experiment